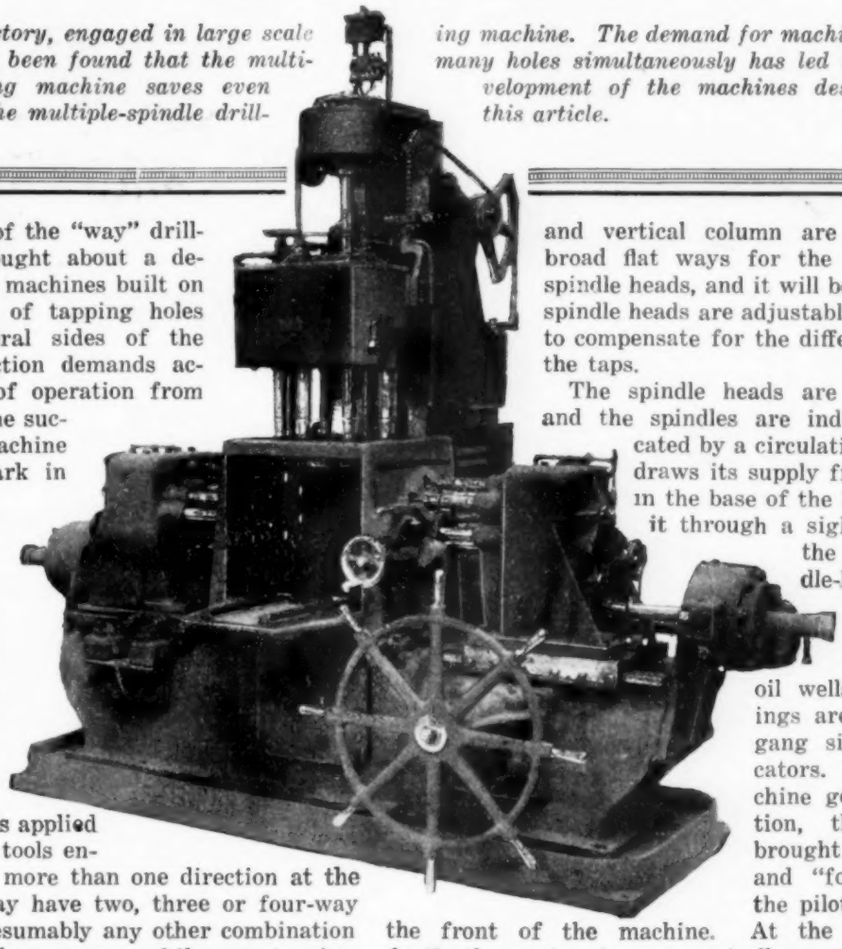
May 6, 1920 American Machinist Vol. 52, No. 19

Foote-Burt "Way" Tapping Machines

By J. V. HUNTER
Western Editor, *American Machinist*

In the modern factory, engaged in large scale production, it has been found that the multiple-spindle tapping machine saves even more time than the multiple-spindle drilling machine. The demand for machines to tap many holes simultaneously has led to the development of the machines described in this article.



THE development of the "way" drilling machines brought about a demand for tapping machines built on a similar plan capable of tapping holes simultaneously in several sides of the work. Quantity production demands accuracy and reliability of operation from all machine tools, and the successful way-tapping machine must be up to the mark in these requirements. It has been necessary to design each type of machine as an individual engineering problem, and the machine which the Foote-Burt Co., Cleveland, Ohio, has built for this service typifies the individual character of the construction required. The designation "way" is applied only to machines whose tools enter a piece of work in more than one direction at the same time; thus we may have two, three or four-way tapping machines or presumably any other combination if required. The general appearance of the way-tapping machine is similar to that of the way-drilling machine, but many details must be altered to build such a machine as is illustrated in the headpiece.

A Problem in Designing

One of the real problems in designing a tapping machine of this class is the proper proportioning of the gears so that a large number of holes of different sizes and pitches of thread may be tapped at the same time.

The sizes tapped by the same spindle head may range from as large as a 1⅛ in. down to a ¼ in. hole. It is stated as an interesting feature of this class of work that the use of a large size tap in a spindle head adds to the success of the results obtained from the smaller taps that may be in use at the same time, since the larger tap tends to pull the smaller ones more uniformly into the work.

The drive for the spindles is carried through a main shaft to a separate reduction gear in a housing on the frame at the rear of each spindle head. Both the bed and vertical column are provided with broad flat ways for the saddles of the spindle heads, and it will be noted that the spindle heads are adjustable on the saddles to compensate for the different lengths of the taps.

The spindle heads are fully inclosed, and the spindles are individually lubricated by a circulating pump which draws its supply from a reservoir in the base of the head and forces it through a sight-feed oiler to the top of the spindle-head body. Oil-level indicators are provided for all oil wells. Other bearings are lubricated by gang sight-feed lubricators. When this machine goes into operation, the taps are brought up to the work and "followed in" by the pilot handwheel on the front of the machine. At the predetermined depth the motor is automatically reversed, and the taps are "followed out" by the pilot wheel until clear of the work and then the heads are run back to a clearance point for loading. At the end of the clearance travel the motor is automatically reversed, so that the taps are again running in their forward direction.

Reversing Motor Successful

The reversing motor has been found particularly adapted for this machine, and has been used with marked success. However, the usual switch control methods for reversing the motor were not found sufficiently positive in operation, and on request a special electrical reversing mechanism was developed by the Electric Controller & Manufacturing Co., Cleveland, Ohio, which eliminates mechanical and depends entirely upon electrical control and is very positive in its action. A view of one of these controllers, Fig. 1, shows the two contact boxes *A* and *B* which provide for the forward and reverse motion of the motor. Adjustable stops *C* and *D* sliding in a T-slot on the base of one of the spindle heads, make suitable contact with the control arms of these switches, pushing

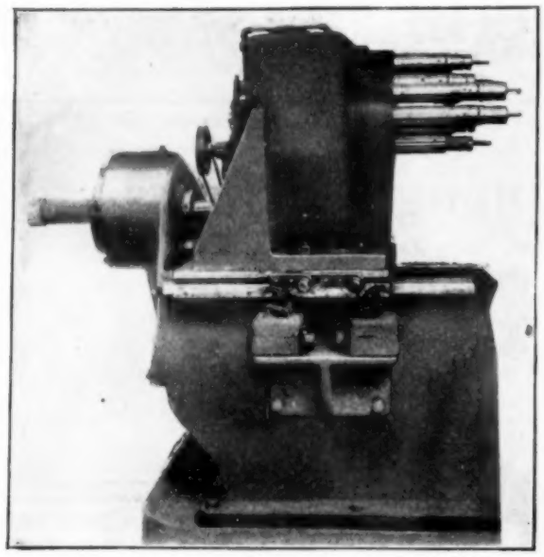


FIG. 1. AUTOMATIC ELECTRIC CONTROL FOR REVERSING MOTOR

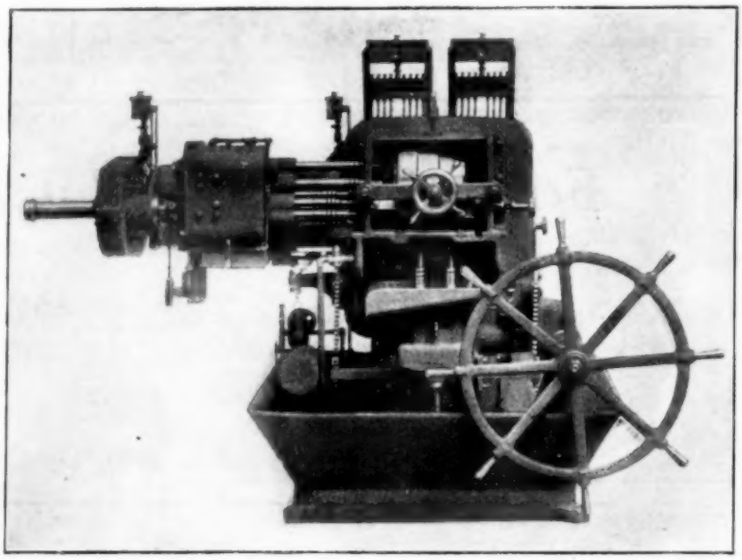


FIG. 2. TWO-WAY TAPPING MACHINE WITH INVERTED HEAD

them down as the spindle head moves forward and back.

The drive motor can be stopped at any point whether going forward or back by a push-button control. This is only used for stopping or starting the machine, or stopping it quickly in case of accident.

A Two-Way Machine

In Fig. 2 is shown a two-way tapping machine which is provided with an inverted spindle head, so that the casting shown in place in the jig may be tapped without inversion, thus making it easier to handle. It is not always advisable to tap from underneath and in another tapping machine, Fig. 3, the cylinder block casting is inverted before being placed in the machine. The use of either of these systems depends upon the judgment of the production engineers who are planning the routing of the work through the shop.

For belt-driven machines mechanical control is provided for the reversing motion and Fig. 4 shows the side of a machine of this type with its forward and reverse belt pulleys, together with a portion of the mechanical shift that is employed. The spindle-reversing motion is controlled by a special lever connected with the clutch which is automatically tripped when the taps have reached their proper depth. These are again automatically reversed into the forward direction upon the return of the head slides to the clearance position.

Power for Reversing

While the head slides are returning to the work they draw up the lower weight shown, and its fall when tripped at the proper instant by a dog, furnishes the necessary power for reversing the clutches. This reversing motion is rapid and permits tapping very close to the bottoms of the holes.

The tapping machines so far described have their spindle heads in the vertical or horizontal planes, but in Fig. 5 we see a machine in which both spindle heads are inclined at an angle of 45 deg. Both spindle heads are counterbalanced by weights.

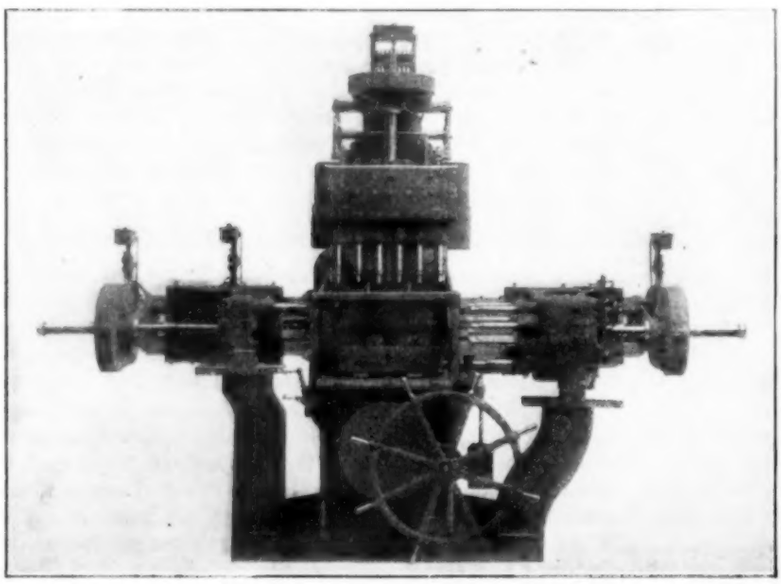


FIG. 3. A THREE-WAY TAPPING MACHINE

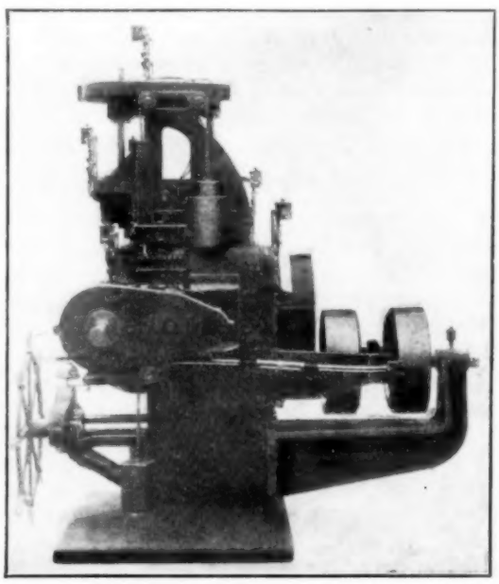


FIG. 4. MECHANICAL CONTROL OF BELT-DRIVEN MACHINE

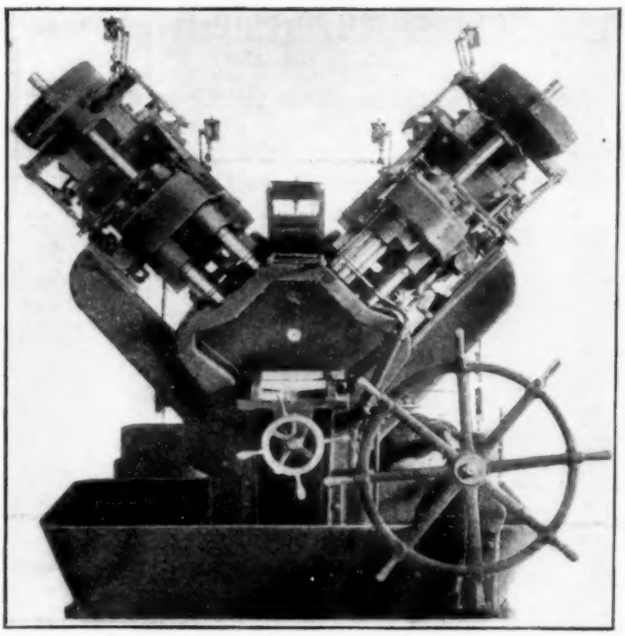


FIG. 5. MACHINE WITH TWO INCLINED SPINDLE HEADS

A three-way tapping machine with one similarly inclined spindle head is shown in Fig. 6, and a cylinder block lying in the fixture reveals the job upon which the machine is employed. The reader will note the guide bar which fits in the crankshaft bearings and aligns the cylinder block. In the last mentioned models it will be noted that the inclined spindle heads are each equipped with a roller running on a guide plate. This supports the out-board weight of the spindle head.

Broaching the Recoil Cylinder of the 4.7-In. Gun

By M. E. Infiorati

One of the problems that presented itself as a broaching possibility during the war was the finishing of the recoil cylinder of the 4.7-in. field and anti-aircraft guns. The length of this cylinder for the field gun is 86 in. and this fact alone seemed discouraging when it was considered as a broaching proposition.

The ordinary method of machining by planing on a special automatic indexing fixture would have been very difficult as at no time could the tool be seen in operation, and the degree of accuracy required was such that a few thousandths deflection of the bar which held the tool would result in a rejected cylinder which might sometimes have had seventy hours of labor expended upon it.

Then, too, resetting would be almost impossible if it were undersize, while if oversize it would have to be scrapped anyway. Regardless of the cost of production, time was the most vital element, as the guns were needed and any delay would be serious.

After making arrangements with the Government arsenal for experimental work, we proceeded as follows: It was first made sure that the 3¼-in. hole was reamed to exact size, within plus or minus limits of 0.001 in. the entire length of the cylinder; this was necessary as the broaches were designed to guide with a very snug fit in this hole to avoid drifting.

A special machine with a stroke of 106 in. and of sufficient pulling capacity was fitted with a suitable fixture for holding the cylinder in alignment, and provision made to get proper lubrication to the broach while cutting. This latter was obtained by inclosing the broach in a pipe at the end of the fixture, and was arranged to be disconnected from the fixture by a quarter turn. The set-up, together with section of the cylinder, is shown in Fig. 1.

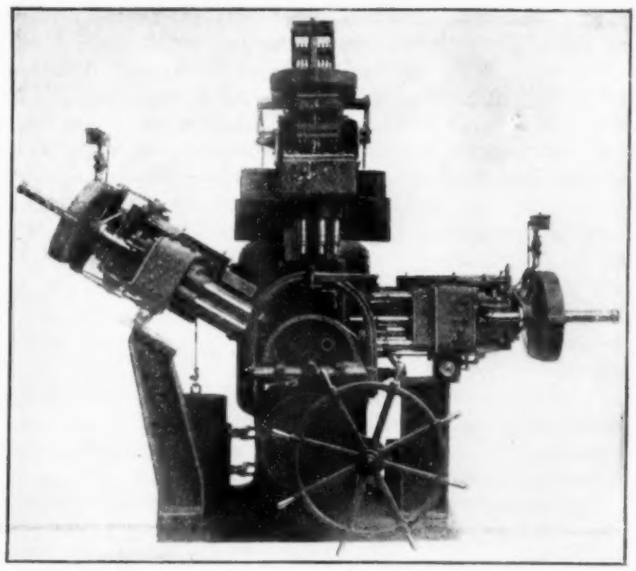


FIG. 6. THREE-WAY MACHINE WITH INCLINED SPINDLES

With the pipe removed, the broach was connected to the pull shank and pushed in place up to its first cutting tooth. The pipe was then connected to the fixture and the lubricant turned on through the pipe at *A*.

After unsuccessfully trying several lubricating compounds, a first-class grade of lard oil was settled upon. It was supplied from a pump which was directly connected to the countershaft and filled the entire tube

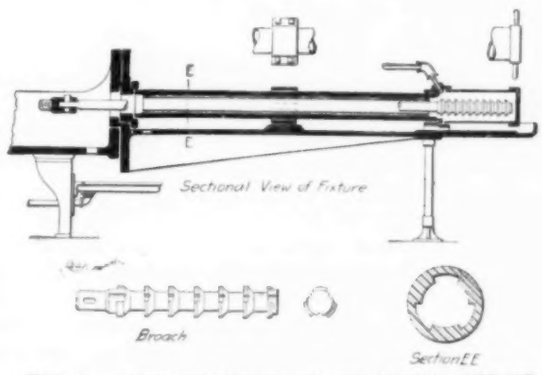


FIG. 1. LINE DRAWING OF CYLINDER SET-UP FOR BROACHING

surrounding the broach. It will be apparent that at all times the broach teeth were completely flooded both at the top and bottom with lubricant—an unusual condition in broaching. To this ideal lubrication we attribute the finish obtained.

The broaches were designed with a groove the entire length of the body to allow the lubricant to flow through while cutting, forcing the warm lubricant out through the front end and keeping the broach supplied with fresh, cool oil. The lubricant was supplied at a temperature of 48 deg. F. and the outflow registered 59 deg. The feed was approximately 5 gal. per minute.

The design of broaches offered several problems such as pitch of teeth, undercut, cut per tooth, chip clearance, etc. The pitch and depth of teeth were designed after figuring the amount of solid material to be removed by each tooth. The thickness of chip per tooth and undercut were governed entirely by past experience on the broaching of similar material. It was decided that a set of forty-eight broaches would be necessary to complete the total depth, which was ½ in., the width across the bottom of each flute being about 2½ in. Approximately 320 cu.in. of metal had to be removed.

Impossible to Determine Pull for Broach

There was no possible way in which we could determine the pull required for each broach, but it was very apparent, knowing the behavior of the machine, that it was pulling close to 95,000 lb.

The cylinder remained very cool while broaching, and the chips were rolled very smoothly, many in lengths exceeding 18 in. x ½ in. wide. The finishing broaches

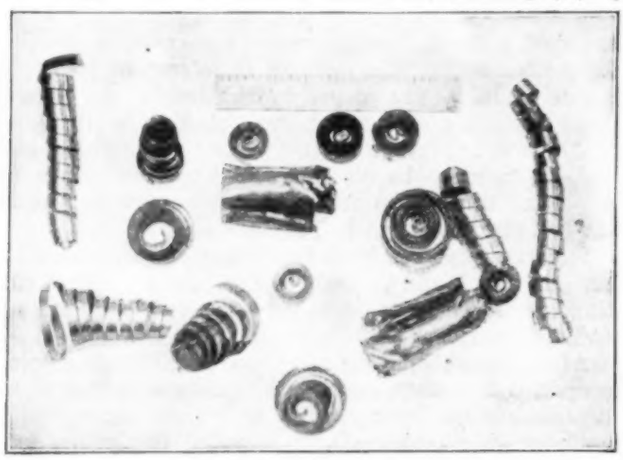


FIG. 2. CHIPS PRODUCED BY THE BROACHES

cut the entire width of splines as shown, sizing the hole to proper diameter and burnishing.

Upon the final inspection by the Government inspectors it was found, by the use of the star gage, that the outside diameter of splines were plus 0.0005 in. in some spots and to size in others, which was within the tolerance allowed.

It was thought that because of the work being so long the broaches would not retain their size for many cylinders, but reports show that 300 cylinders were broached by one company using this method and the broaches showed less than 0.0005 in. wear on the outside diameter.

The Time Required for Broaching

The time required for broaching the complete cylinder was 6½ hr. and assured interchangeable product; while the time required for machining by other methods was 67 hr. without any assurance of interchangeability. It was not necessary that the men who handled the broaching be first-class mechanics.

Some of the chips removed by the broaches are shown in Fig. 2.

"Notice that the first part of manager spells 'man'."
—*Forbes Magazine* (N. Y.).

Arc Heating in Ship Repairs

By I. B. Rich

The growth of the use of the electric arc in shipbuilding and repair work is quite a surprise to those who have not kept pace with it. As an example, the electric welding barge of the Alabama Drydock and Shipbuilding

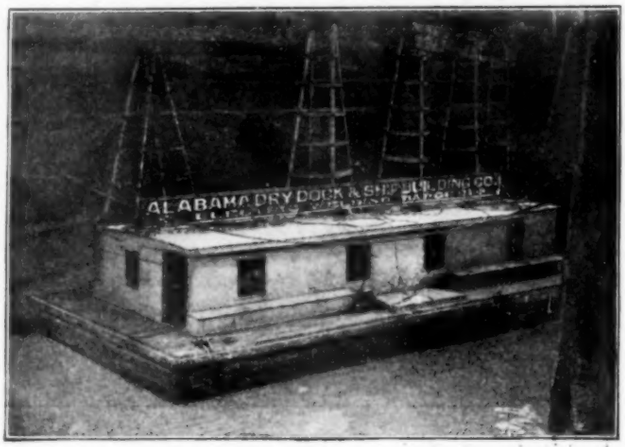


FIG. 1. ARC WELDING POWER PLANT

Co., of Mobile, Ala., shows to what an extent this has become a part of shipyard equipment. This barge contains a whole power plant, consisting of an internal combustion engine and a large generator and can be towed to any part of the yard so as to have the power readily available.

Fig 2 shows the bow of a ship which is having

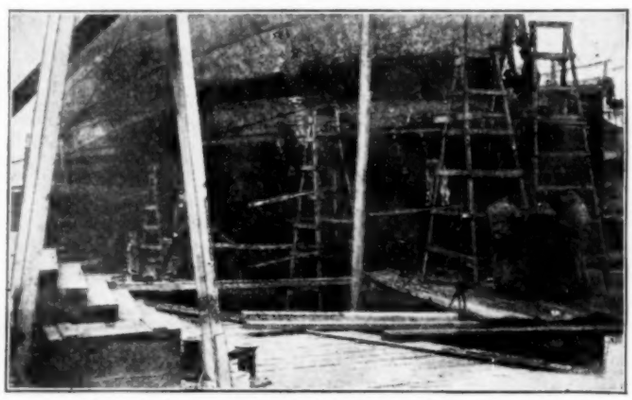


FIG. 2. THE ARC IN REPLACING PLATES

a number of plates replaced, and here the electric arc plays an important part in cutting out rivets and in other ways, taking the place of the hammer, chisel and punch of the older methods.

A booklet entitled "Public Utilities, City of Nitro, West Virginia," has been issued by the Charleston Industrial Corporation, which is operating the city of Nitro at the present time. The booklet gives a technical description of the public utilities of Nitro, which were planned for a city of 35,000 before the city was actually built. Besides numerous illustrations of the power equipment and the public utilities, maps showing the layouts of the water, electric, fire alarm, sewer and railroad systems are given.

A Comparative Test of High-Speed Steels—I

By A. J. LANGHAMMER, M.E.
Industrial engineer, Thompson & Black, engineers and accountants, New York and Detroit.

In the last sixteen years the use of high-speed steel has grown from practically a metallurgical and manufacturing experiment to what is today one of our most important economic and industrial factors. The principal reason for its wide application is the rapid growth of quantity production methods as applied particularly to the automobile, machine tool and allied industries, and the introduction of scientific management in these works.

TODAY there are dozens of brands of American-made high-speed steel on the market, and in the last eight months some of the famous English brands have again made their appearance. British-American brands too are very much in evidence, particularly in the crucible mills. Both electric-furnace and crucible steels are well represented, though the latter are still very much in preponderance.

High-speed steel selling methods of today leave very much to be desired. In general, the steel is sold by voluble salesmen who know nothing of their wares, have never been in a steel mill, and have never graced the floor of a machine shop. Fortunately, there are always some saving exceptions. It is indeed astonishing how little the average steel salesman knows of his product. If an interview is granted him, he begins by nonchalantly announcing that his brand is the best in the market, and that he can increase your production anywhere from 50 to 100 per cent, or more. When pressed for supporting data, he refers you to a local machine shop or some large manufacturer out of the city. During the war, Government plants and arsenals were quoted elaborately as using solely his steel. If you took the trouble to investigate, it would invariably develop that the particular brand in question had never been used, or that a small sample had been left gratis by the salesman for test purposes. Usually the test disclosed a mediocre or even a poor steel. The damage done to the steel company by such misrepresentation is almost immeasurable, for though it may later improve its product or even bring forth a superior brand, you still retain that bad taste from the interview and are suspicious, if not antagonistic.

Special Samples Prepared for Tests

Sometimes you meet in steel salesmen a canny old-time mechanic who has forced his way into the selling business and who is wiliness personified. If such a man is permitted to have a hand in directing the test, and the man in charge of the test is not himself an expert, then the result is never in doubt. The steel that the "old-timer" represents will win out.

High-speed steel salesmen often have access to a supply of specially-prepared steel for test purposes. At the mills a heat may be prepared which has the best possible composition and subsequent workings and heat treatments are very carefully performed. When this practice is not followed, a batch of "regular run" steel that has shown exceptional performance under test is retained for test purposes only. Obviously, when the steel company begins to fill orders, it will ship from the regular run of stock, which is inferior in quality to the "special" bar submitted for test purposes. In justice to the steel manufacturers it must be said that such practices seldom or never reflect the true policy of the companies represented (or misrepresented).

Most steel companies, too, manufacture several grades of high-speed steel. One of the grades is usually superior to all of the others and is the best steel that experience and careful manufacture can produce. This steel is then used for test purposes and should it win a place when the final selection is made, great care must be exercised to see that the "best grade" is received on subsequent shipments and not specimens of the poorer grades.

High Cost of Cheap Tool Steel

Much is found wanting in the average buyer or specifier. In most plants the purchasing agent decides on the brands, and he is naturally gullible on this subject. His decision is usually based on price, which to him is all important, while in reality it constitutes practically a negligible item. Then, too, if market conditions seem to warrant, as they do in recurring stress periods, he will buy as much high-speed steel as he can and of every available brand. In this way his errors are multiplied, for not only does he get steel which is primarily poor, but also such rejected stock as has been accumulated by the steel salesmen.

Under modern manufacturing conditions it is of utmost importance to know the comparative capabilities of the various brands of high-speed steel on the market. This applies to the small machine shop as well as the giant works. As stated above, the first cost of the raw material in a high-speed tool is practically negligible. This is true because the labor cost for the machining of such a tool is usually several times that of the raw material. Also, when a tool is made up of an inferior grade of steel, it may be scrapped after an attempt at hardening before it ever gets into the shop, thus producing an immediate combined loss of indirect material, labor and overhead. If the tool should successfully pass through the hardening room and subsequent inspection into the machine shop, trouble at once begins. Production is decreased, more work is incurred for the machine operator and tool grinder due to the increased tool changes, and costs increase accordingly. Spoilage or scrap also takes a jump and the costs increase again.

When the capabilities of certain brands of high-speed steel are to be determined, it is imperative that the test be conducted under the constant supervision of a competent observer. This man need not be a technical graduate, but he should be a good mechanic and in addition he must possess the mental and moral qualities that permit him to follow instructions explicitly. The man in charge of the test, however, must be familiar with all the variables that affect the life of a cutting tool. He can then correctly plan the complete details of the test which will be executed by his subordinates. One of the reasons that large quantities of relatively poor high-speed steel are used annually is that such tests are conducted by incompetent men.

In addition to the objection to the use of a large num-

ber of miscellaneous brands of high-speed steel noted two or three paragraphs back, there is that of difficulty in heat treatment. A standard method of heat treatment is all-essential for uniformly good results. Mediocre or poor grades of steel do not in general permit high heats and must be treated accordingly. If the next tool is made of a good steel which must be subjected to a high heat for best results, the chances are very much against its proper hardening, and the result is confusion, increased difficulties, more work, and finally a general run of poor tools. When quantity production methods are employed, as for example in a cutter or twist drill plant, these bad conditions are considerably augmented.

With a selection of brands that permit a uniform heat treatment, the tool hardener has an ideal condition and his work will show results.

Carbon Steels

Carbon tool steel, which was the earliest form of cutting steel used in machine shops, is now used only in relatively small quantities except in cutting non-ferrous metals and non-metallic materials. It has a wide and universal application, however, for hand tools such as chisels, punches, dies, shear blades, cutlery, broaches, hand taps and reamers, etc. Large quantities of plain carbon steel are also used for forging dies, hammer dies and machinery parts, though in these instances elements that promote toughening, resistance to wear and shrinkage are usually added to the alloy. As a cutting tool it fails because of the low duty that can only be exacted and the premature dulling of the cutting edges.

Self-Hardening Steels

Mushet, or self-hardening, tool steel (so called from the name of its inventor) was the immediate successor of carbon tool steel. This steel usually contained from 6 to 9 per cent of tungsten, 2 per cent of manganese, and a high percentage (about 2) of carbon. With the introduction of Mushet steel, cutting speeds were increased about 60 per cent, and this record stands out as one of the most notable achievements of that time, though not fully exploited. Today this steel is obsolete, but it was of extreme usefulness in that it formed an indispensable link in the development of modern high-speed tool steel. It is an obsolescent product because practice today demands a cutting speed far in excess of its capabilities.

High-Speed Steel

Self-hardening tool steel was the immediate predecessor of high-speed tool steel. The composition of the average high-speed tool steel (by actual analysis of sixteen different brands) is as follows: carbon, 0.60 to 0.70 per cent; tungsten, 16 to 18 per cent (although one or two brands go as high as 22 per cent); vanadium, 0.75 to 1.05 per cent; chromium, 3 to 4 per cent. In addition to these "standard" elements, some brands contain also uranium, cobalt, manganese and molybdenum. Sulphur and phosphorus average from 0.02 to 0.04 per cent and the same minimum amount of silicon is generally present.

High-speed steel enabled an increase of about 400 per cent in cutting speed over Mushet or self-hardening steel. The feature wherein the tools made from this steel differ from and exceed in performance the tools made from the preceding steels is their ability to maintain a sharp, strong cutting edge while heated to a temperature far above that which would cause "failure" or "breaking down" of the cutting edges on tools made of the simple steels. As a matter of fact, the sharp cutting edge is maintained until just a short time before failure occurs. Carbon steel tools, on the other hand, show wear or dullness of the cutting edge as soon as they are put to work. The heat generated by the friction of the chips on the tool when cutting steel, plus the pressure, is great enough to weld small bits of the chip to the tool at some distance (depending principally on the depth of cut) back of the cutting edge proper and to wear a groove into the lip surface. The property of being able to retain hardness and cutting ability at a red heat is termed "red hardness." In the early days, the principal objection to high-speed steel was the apparent inability to produce a good finish. This handicap was largely imaginary and not well founded, for in the general run of work no such difficulty is experienced.

Stellite

As self-hardening tool steel was supplanted by high-speed tool steel, so the latter will in some cases give way to stellite where this alloy is applicable. Stellite is made up of approximately 65 per cent cobalt, 25 per cent chromium and 10 per cent molybdenum. It is extremely hard, quite brittle and possesses the quality of red hardness to a very marked degree. On cast iron, stellite has a cutting speed of 100 per cent above high-speed steel, while on bronze it may run as high as 700 per cent faster. On soft steel, honors are about even, depending on conditions. Stellite, however, is not adaptable even to cast iron or bronze when the tool is subjected to sudden shocks, on account of its brittleness.

Much work is being done in developing both stellite and similar alloys, but to date none of the rival products tested by the writer have equalled stellite in performance or adaptability. The range of utility of stellite is greatly increased, due to the fact that small rectangular or square sections can be readily welded in an electrical welder to large steel shanks, which arrangement gives a high-duty tool of low cost. The same procedure, of course, is applicable to high-speed steel.

Cast Tool Steels

Within the last two years several very promising brands of "cast high-speed steel," both air- and oil-hardening, have been produced in this country. In some cases the alloy has a composition very similar to that of a good brand of high-speed steel, while in others no tungsten is used. Distinct advantages are claimed which greatly reduce factory costs. Thus it can be cast readily into almost any intricate shape such as dies for presses, milling cutters, core drills, form cutters and other special high-duty working and cutting tools. These castings, which usually anneal readily and machine easily, require but a small percentage of machining as compared with the tool made from a solid bar, whereby the labor cost is reduced very appreciably.

When placed in actual operation, some of these tools have produced as high as ten and twenty times as many parts as a regular high-speed steel tool on the same task, with the consequent saving in costs. Milling cutters made of such cast high-speed steel have been seen by the writer in use, and their performance appeared to be excellent. In this case, however, the duty was not very heavy, though the cutting speed was high, so that

too much importance could not be attached to the one demonstration. Cutters of such material and of intricate design were at once ordered by the author's firm, but to date they have not been tested. In view of the recorded successes of "cast" high-speed steel and the large amount of experimental work that is being done with it, developments of extreme importance can be expected in the near future. This is the more interesting because the idea of casting high-speed steel is diametrically opposed to one of the fundamental requisites of a good high-speed steel, which is that the ingots must be of sufficient size that the proper reduction in area occurs in the working, with the resultant refined structure and hardy constitution.

English Brands

English steel makers are doing a great deal of work on high-speed steel, supposedly in an effort to produce a superior grade. As their efforts are chiefly confined to securing a substitute for tungsten, their object is probably to produce a cheaper steel. Molybdenum (already exploited by American metallurgists and discarded) is understood to be the principal element that is receiving their attention. Cobalt, too, is being thoroughly investigated, although both these elements are at the present time more expensive than tungsten. One English manufacturer has actually brought out a so-called "tungsten-less" high-speed steel that is being offered at an unusually attractive figure. In an actual cutting test, when run against a good brand of high-speed steel, it proved a failure. There may be quite a market for such a product, however, where a cheap cutting steel is desired for limited performance, or even for general work on aluminum, brass, or such easily machined metals. Again, this steel may be vastly improved, thereby increasing its usefulness.

Influence of Chemical Composition

It has been the writer's experience that the analysis of a particular brand of tool steel is but an indicator as to its ultimate capabilities. By this is meant that just because a high-speed steel has 18 per cent tungsten and other elements in proportion, it cannot be classed as a good steel on this basis alone. If, on the other hand, the analysis shows the presence of but 10 to 12 per cent tungsten, and no other substituting element, then one can readily assume that it would be a waste of time and money to investigate further such a steel. Since, broadly speaking, analysis does not in any way guarantee the performance of a tool, it is a grave mistake to order or purchase high-speed steel on the basis of specified composition only, which unfortunately is practiced by some large manufacturing industries. During an efficiency test, one of which is later described, it was always our policy to impress carefully upon the steel men that to us, chemical analysis as such meant nothing except as an indicator; the final requisite was that subsequent shipments of high-speed steel duplicated or closely approximated the performance of the test specimen. This usually served a good purpose, for not only would the salesman instruct the mill to inspect rigidly the first large shipment that was sent, but he would emphasize this point from time to time, because he knew that the steel would be subjected to a "check" test and the performance would have to be good.

The qualities ascribed to the various elements contained in high-speed steel are as follows, it being understood when discussing one that the other requisite elements are present in proper proportion:

Tungsten

Tungsten has long been credited as being the most valuable element in high-speed steel. The principal characteristic is that with a moderately rapid rate of cooling from high temperatures, tungsten steels are exceptionally hard, and this hardness is retained even when the steel is again heated to a high temperature, because it offers a strong obstruction to the various changes from austenite to pearlite. This element, too, is very heavy, its specific gravity being about 19.3, it apparently diffuses very slowly, and in addition it is the most infusible element in steel with the exception of carbon. It is these three factors that may cause considerable trouble, especially in the crucible process, if in charging the tungsten is not placed at the top of the mixture so as to counteract in a measure its tendency to settle. If this tendency were not counteracted, an ingot of irregular composition would result. Tungsten raises the strength of the steel and also the temperature of fusion.

Vanadium

The effect of vanadium is to increase the hardness or red-hardness of cutting tools and also the resistance to wear. It has a strong affinity for oxygen and therefore probably acts to good advantage as a purifier. Vanadium greatly increases the strength of steel up to a certain percentage, though this limit is usually exceeded considerably in high-speed steel to get the effect of red-hardness.

Chromium

The effect of chromium in high-speed steel is to increase the hardness or red-hardness and also the life of the cutting edge. It also adds strength and especially toughness, thereby increasing the ability of the tool to withstand shocks and sudden strains. European steels, due presumably to their relative cheapness, use as high as 10 per cent of chromium.

Molybdenum

The use of molybdenum as a major constituent has in general been discontinued. High-speed steel with a goodly proportion of molybdenum is generally characterized by irregular performance, which is said to be due to the ease with which it is volatilized. Such tools too often exhibit a tendency to crack in quenching. In general, molybdenum possesses the same quality of producing red-hardness as tungsten, though in a greater magnitude—possibly two or three times as great. This advantage is apparently lost almost entirely by reason of its instability, especially after re-hardening. However, European makers are now advocating the use of a relatively high percentage of molybdenum as a substitute for tungsten.

Uranium

To uranium is generally attributed the quality of increasing the red-hardness, ability to withstand shock and resistance to wear. It is also a powerful agent for removing gases, principally oxygen, nitrogen and their compounds. This element, however, apparently exhibits characteristics which call for careful mixing and expert handling at the steel mill. It appears, too, that the elec-

tric furnace is most adaptable for the manufacture of this steel.

COBALT

To cobalt is usually attributed the quality of being able to cut extremely hard steel. It is generally conceded that an excess of cobalt produces a premature deadening or softening of the cutting edge. American manufacturers are apparently using little or no cobalt at present, probably due somewhat to its high cost.

MANGANESE

The effect of manganese in high-speed steel is to strengthen or toughen the body, at the same time allowing it to be worked readily. Apparently the effective range is very close, and when this is exceeded, excessive breakage results. It is believed that chromium is in general substituted for manganese.

CARBON

Carbon is the element which forms the basis for all steel hardening and is a requisite constituent. In high-speed steel it is usually present in smaller amounts than would produce satisfactory results in the hardening of simple steels. This element in high-speed steel acts in a somewhat different way from what it does in the simple steels. In high-speed steel some of the carbon unites with the tungsten and chromium to form carbides of these two elements. The carbides in high-speed steel, especially tungsten carbide, are more insoluble than the cementite of the carbon steels and therefore, for hardening, a much higher temperature must be resorted to. The effect of carbon in connection with the various elements discussed above is beyond the scope of this work and will therefore be omitted.[1]

The uncertainty of heat treatments recommended by steel makers is responsible for a great amount of cutting tool troubles and very much more accurate data should be forthcoming at an early date. This is especially true of the better steels. Precise information as to the proper time-temperature factor required for forging, pre-heating, heating and hardening, and drawing, at least, should be given. Variations for tools of different duties should be provided. Quenching mediums, "drawing mediums" and the time required for these operations should be given careful consideration.

To illustrate this point, the specifications of about twenty leading makers of steel (the majority of whom were represented in a test to be described later) are listed in Table I, and attention is invited to the apparent uncertainty in a large number of directions. For the sake of simplicity only the pre-heating, hardening and drawing temperatures plus the quenching mediums specified for "lathe and planer" tools are given.

TABLE I. MAKER'S RECOMMENDATIONS FOR TREATING LATHE AND PLANER TOOLS

Brands	Pre-Heating Temperature, Deg. F.	Hardening Temperature, Deg. F.	Quenching Medium	Drawing Temperature, Deg. F.
1	1600–1650	2250–2300	Oil until black, then cool in air	800–1000
2	No mention	Heat nose until it sweats, then quench quickly	No mention	No mention
3	No mention	About 2300	Cool in air blast until nose is cold	No mention
4	Bright red	2250	Tempering oil	1000–1100
5	1700	2300	Lard-linseed or fish oil	400–600
6	1500–1700	2150–2400	Oil or air blast	No mention
7	No mention	About 2200	Air blast or oil	Draw when necessary
8	Red heat	2200–2250	Air blast or oil	500–600; 100–1100 for toughness
9	1400	2200–2300	Air blast or thin oil	700–750
10	Red heat	About 2300	Air blast or oil	No mention
11	1400	2200–2300	Thin oil or air blast	700–750
12	1375–1450	2250	Oil or air blast	500–750
13	1400	2300	Oil	1065
14	1500	2200–2300	Cottonseed oil	No mention
15	1400–1500	2250–2300	Oil or lead	1050
16	1400	2200–2250	Oil or air blast	No mention
17	1450–1550	2150–2250	Oil or lead	When necessary
18	No mention	About 2300	Fish or tempering oil	650–1130
19	Cherry red	White heat	Oil	No mention
20	Bright red	Melting or running point	Air blast	No mention
21	1750–1850	2250–2300	No mention	No mention
22	Cherry red	White sweating heat	Oil	No mention
23	About 1400	2200–2300	Air blast or thin oil	700–750 in lead
24	No mention	Slowly to 2100	Air blast	No mention
25	No mention	2300	Air blast or oil	None required

[1] For more detailed information concerning the influence of the various chemical elements in high-speed steel, the reader is referred to the works of Messrs. Arnoldi E. T. Edwards, Carpenter, C. A. Edwards, Read, etc., in the *Journal* of the Iron and Steel Institute.

Hollow-Spindle Dividing Head

BY W. C. STEUART

The hollow-spindle dividing head, shown in Figs. 1 and 2, will be found a convenient adjunct to the milling machine. It is intended for use in milling squares,

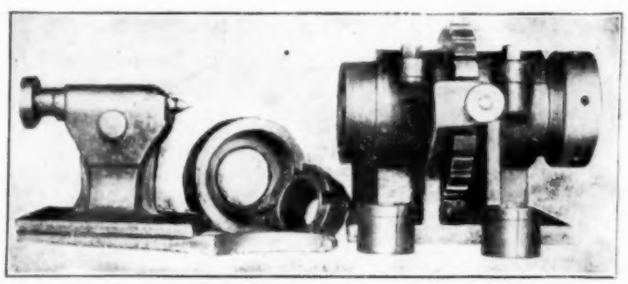


FIG. 1. HOLLOW-SPINDLE DIVIDING HEAD

keyways, etc., on work too long to be held between the centers on the ordinary machine.

The spindle has a $2\frac{1}{16}$-in. hole and is fitted with taper draw-in chucks at both ends. The chucks are operated by threaded collars and a spanner wrench. The split bushings shown in Fig. 1 are provided for work of varying diameter.

For dividing, a notched index plate and a hardened index pin are used.

The work for which this head was designed does

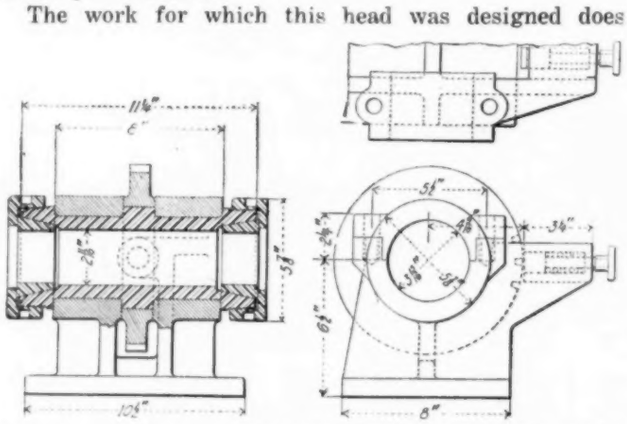


FIG. 2. DETAILS OF HOLLOW-SPINDLE DIVIDING HEAD

not usually call for finer divisions than are provided, though a worm-gear indexing device could be substituted if the work required it.

The tailstock is of the usual type.

Making Employees Interested in Their Work

By HARRY DEXTER KITSON, Ph.D.

Psychology in business is as old as the hills, but only recently have we come to recognize it by that name. Here is a pertinent suggestion that may well be given careful consideration by any man whose job it is to get production.

IN THE course of a recent conversation, the office manager of a manufacturing concern complained: "One of my chief difficulties is to get the employees to take an interest in the affairs of the firm." "How do you mean, take an interest in the affairs of the firm?" I inquired. "Why, to look upon it as theirs—to identify themselves with it—to throw themselves into their work, heart and soul. I can't describe what I mean but I can give you an example of it. Look at those two fellows," and he indicated through a glass partition two young men sitting at adjacent desks. "Bill, there, has it. He treats the company's business as though it was the most important thing on earth. Any time there is a rush of orders demanding immediate attention he stays on the job till it is finished. Many's the night I've found him here working till nine or ten o'clock. He is responsible for the motto on our letter-head, 'Every letter answered the day it is received—every rush order filled the same day.' He has bought some stock in the company and has been promoted twice in the past year.

"Now George illustrates what I mean by lack of interest. He is just as bright as Bill—brainier, I think—but he isn't worth half as much to us. Oh, he does all that is asked of him in an honest routine manner, but he never becomes enthusiastic and he never goes a step beyond. At the first tinkle of the closing gong he dashes to his coat locker, rams on his hat and rushes to the news-stand to see how the ball-game came out. He's a nice cub with a pleasing personality. We could use him to good advantage higher up, but he doesn't take interest enough in the business to warrant burdening him with weighty responsibilities. We've got a lot like him in the office and factory and if we could get them really interested in things around here we could increase the efficiency of the plant a hundred per cent."

This executive voiced a complaint universally made by the heads of big business. True, they find it difficult to express, usually using terms like "morale," "esprit de corps" and other words of subtle French origin which everybody throws off glibly but refrains carefully from amplifying.

The reason for this vagueness is not hard to see. Interest is an elusive thing. Nobody ever saw a particle of interest; analyzed "morale" into its chemical constituents; or weighed a morsel of "esprit de corps." All our physical measures fail us in dealing with this thing. We know, however, that it exists; we have felt it in varying degrees of intensity; but the feeling is not a physical thing—it is psychical. This being the case, we must go to the science of psychology.

A description in terms of technical psychology, however, will not help us greatly in answering the plaint of the business man. What we want is a practical exposition of the thing and a translation of it into terms of everyday life. This we shall find in the writings of Professor James, who, were he living in these days of business psychologizing, would undoubtedly be one of the most sought-after of business consultants. He would respond, too, with the best psychological technique at his command for his zeal for adapting great truths to the needs of the practical man amounted almost to a passion. We shall find Professor James talking much about the relation of interest to mental efficiency, and knowing his delightful faculty for expressing important principles in everyday language, we shall not be surprised to see him use a racy figure of speech. Thinking of the lowly crap game he likens a good mind to a "high" die: "The performances of a 'high' brain are like dice thrown forever on a table. Unless they be loaded, what chance is there that the highest number will turn up oftener than the lowest?" "Can consciousness increase its efficiency by loading its dice?" That is, by applying the pressure of certain interests unto the mind of our workers can we increase their output?

The psychologist answers this question in a decided affirmative. He says that the mind is bound to have some interests. Men cannot think without taking an interest in something. Even the fluffy pate of Geraldine being fastidiously coiffed between customers at the basement glove counter, holds interest in something—a dandyish floor-walker, a marcelled movie hero, the semi-weekly dance at Dreamland.

Some interests are accidents of the environment; some, assertions of will. Sometimes the interest is foisted upon the individual by another person and sedulously fostered, as when the female of the species definitely sets out to win the interest of a mate.

Since interest can be thus cultivated an employer has only to set out determinedly to follow the laws of mental action and he can direct the interest of his employees into the desired channels.

We might profitably pause to consider this point. For there is a mistaken idea abroad that interests are altogether innate things; that a man is interested in a thing because he was created with predispositions in that direction. We constantly hear such expressions as: "I can't get interested in golf, or French music, or tariff problems; I was born with an interest in the violin; or the Republican party, or cabbage."

Such ideas are fallacious. Every one of these interests is acquired. Professor James goes so far as to assert: "An adult man's interests are almost every one of them artificial; they have been slowly built up. The objects of professional interest are most of them in their original nature, repulsive; but by their connection with such natively exciting objects as one's personal fortune, one's social responsibilities and especially by the force of inveterate habit, they grow to be the only things for which in middle life a man profoundly cares." Not only does the psychologist affirm that our occupational interests are acquired, he goes further and declares that they might have been cultivated in widely different fields. "Any object not interesting in itself may become interesting." A golf enthusiast might have become just as deeply interested in horseback riding; a specialist in early Victorian literature might just as readily have developed an interest in chess; a manufacturer of saw-mill machinery might just as easily have cultivated an interest in diamond smuggling. He need only to have been subjected at the proper time to the appropriate stimulations.

So the business executive may take heart. Geraldine, if properly aroused, may be made just as thoroughly interested in the manufacture and sale of gloves as she is in the latest modes of hairdressing. George, poring over the sporting-page when he should be posting remittances, may be so transformed that he will be equally interested in bucking up the collections of the firm.

The course for the employer to pursue is to start a campaign toward the development of interest on the part of the force. This may seem contrary to the doctrine of responsibility as commonly stated. The employer insists: "It is up to the man himself to develop interest in my line." This is, however, not exactly a fair demand. It is incumbent upon the employer to offer stimulants to this interest. As business executives become aware of the magnificent human material just awaiting the dynamic touch of a motive, they will begin to select certain bright young people and definitely cultivate their interests. The fact that transformations such as those just indicated are possible should challenge the will-power of every employer.

How accomplish the transformation? There's the problem. Let us consult our psychologist again. He gives this simple formula for appealing to the employee: "Begin with the line of his native interest, and offer objects that have some immediate connection with these."

One such interest that will always serve for a starting-point is the money-interest. It is present in every individual and can easily be shown to be connected with the interests of the firm. The task of the employer is to show the employee that as he works to increase the profits of the concern, he is augmenting his own earnings. The demonstration of this will have to be apparent, concrete—in terms of the pay envelope—and immediate. Its form will depend upon the wage scale and system of bonus or profit-sharing in operation. Indeed, the practice of giving bonuses and shares in profits is in itself an application of our formula. Corporation baseball teams, bowling leagues, musical organizations, benefit associations, and the like have the same basis, and the adoption of these devices mark an important step in the identification of the interests of the employee with those of the firm.

To search out the interests of the employee and offer them expression is only the beginning. The new bookkeeper may be most zealous in playing on the departmental bowling team and still lack interest in the firm's product. Our psychological mentor gives further advice: "Next, step by step, connect with these first objects and experiences the later objects and ideas which you wish to instill. Associate the new with the old in some natural and telling way, so that the interest being shed from point to point, finally suffuses the entire system of objects of thought." This means that effort must be unremitting and cumulative. The institution must be so organized that a continuous stream of ideas will pour into the mind of each worker and mingle with the ideas already there.

This fact might be stated as a general law: In order to make a man interested in a thing, give him information about it. Our baseball fan furnishes an excellent example of this. What is the secret of his interest in the game? The fact that he knows so much about it. His mind is crammed full of facts—the standing of each team in the league; the batting average of each player; the intimate details about the game at Cleveland last week. All this information extending back several years is catalogued in his mind, ready to be compared with today's results. That is why he awaits the news of the afternoon game with such keen interest and haunts the desk of the bookkeeper, talking baseball incessantly.

Now this psychological principle should be utilized by the employer. He should tell his employees many things about the business, saturating them with facts. For example, in a cotton mill every workman should know the facts about the invention of the cotton gin; the life

of Eli Whitney; the different stages in the invention of textile machinery and the struggles of some of the early inventors. Such facts are powerful stimulants to observation and inventiveness.

The practical executive who reads these lines may interject: "We have already installed a library stacked with technical and historical books, but it is hard to make the employees read them."

The same executive must realize that the dissemination of such information must not be a haphazard and sporadic matter. It must be provided for by some definite agency within the organization. If a corporation school is maintained for giving instructions in spelling, history and the like, it may well give courses in industrial history and industrial biography.

Or the dissemination of this information may be delegated to some department like welfare, research or house organ. Its head will be a "morale" executive, with duties frankly those of a press-agent—to propagate information about the firm and its affairs among the employees. He must work through all departments and agencies: library, house organ, corporation school, directorates of employee associations, athletic clubs, etc.

Another Psychological Principle

This is not all. There is another psychological principle that we must employ: In order to make a man interested in a thing, arouse his motor activity in its behalf. The more one does for an enterprise the more deeply does he become interested in it. This principle is habitually employed by clubs, churches, colleges and philanthropic institutions which choose as members of the board of directors those whose interest they wish to enlist. When Forbilt College desires to obtain support from Millionaire X, it first elects him a trustee. Then it constrains him to attend a board meeting and puts him on an important committee. In trying to solve the problems of the ways and means committee, he becomes so deeply interested that he opens up his exchequer and makes a substantial gift to the annually deficient budget. One step of motor activity leads to another, finally culminating in the donation of the long-prayed-for physics building.

A wish frequently voiced by the heads of big business is that every employee may have a deep affection for the firm. To attain this end we have simply to apply our twofold formula: disseminate information, and start motor activity on behalf of the firm. One firm has carried this out by preparing a history of the house, including biographical sketches of the founders and of employees of long standing. This first appeared in consecutive issues of the house organ circulating among the employees, and was so effective that it was later made into a booklet which is presented to every employee on his first day of employment. Another firm has made its history still more impressive by presenting it dramatically at one of the regular "get togethers" of the personnel.

Developing Loyalty

The following incident shows how one manager proceeds to develop loyalty within a certain type of man: Job Grimson was a dapper youngster of considerable mother-wit but so inordinately fond of himself that he never became very much interested in the affairs of the firm. The manager was sure Job could be very useful if he could transfer that self-interest to the company's product. One day, noticing how Job strutted past the stenographer's cage, he got an idea. Calling him from his preening he asked him how he would like to be reception executive, his duties being to take visitors over the establishment and explain the product. Job expanded to the idea. He gladly undertook a course of instruction which would fit him for the job and nosed into odd corners collecting information with great avidity. When he had absorbed a sufficient amount he was permitted to take his first visitors through the plant. He did it gracefully and effectively as the manager had anticipated, and the desired result followed. For as he dilated upon the economical methods of handling raw material, the efficient routing system, the new machines that did the work of three men, the number of cars loaded daily, he began to act as though it were his personal property he was exhibiting. Indeed, he developed the habit of looking upon the entire plant as his. This was the very attitude the manager wished to encourage, and it resulted in boosting Job up to a responsible managerial position. The device proved so valuable in Job's case that it was permanently adopted and has raised the work of many a young fellow from a level of mediocrity to one of enthusiastic co-operation.

Such is the mental attitude in which the interested workman will perform his task, and in the beneficent results both employer and employee will share. To secure them you need only "Load Your Dice."

A Metric Nightmare

By Raymond F. Fletcher

Once upon a time a Business Man awoke at Morn in the far-famed city of Winds. 'Twas a historical morning, for it marked the advent of a long-heralded El Dorado, and men that day were to become Metric Brothers everywhere. From the land of California Oranges, and Mack Sennett Bathing Blossoms had come this wonderful idea. All Measurements were to be reduced to Delightful Simplicity. In wondrous Sunset Literature, Ford stories were Preached which had

resulted in the Banishment of the Yardstick, the Tape-Measure, and the Milestone to the land of Things That Were.

So it was the First day of this Metric Paradise, as the T. B. M. marched in Dignity to the Lavatory.

"Sorry, Sir," said the Slave who guarded the Portal. "The Hot water is Not, also the Gas and Electricity.

No more service from the Central Station until new Volume Meters can be made. None can be made because all the Lead Screws and Screw Cutting Gears for every Factory Lathe in the country must be changed. All the Small Tools and Fixtures have been scrapped, Sir. No new Patterns, Tools and Jigs can be made because the men do not understand the new system."

Unlaved and unshaved, the Victim went down to breakfast.

"Very sorry, Sir," he heard again, "there is no Food, Sir. The Grocer and the Butcher have Suspended until they can replace their Scales and Weight-Beams. Anyway, there are no legal Baskets in which to deliver goods and the Cook left when they destroyed her Cook-Book and Recipes."

Unfed, our Friend sought the Porch and the Milkman. But, Milk-Bottles too were out of date, and a Litre

Bottle had not been thought of by the Geniuses of the World Fade Klub.

Very much out of humor, our Hero started for his Place of Toil. "Sorry, Sir," the taxi-driver told him, "Our new Damages will be $10 a Kilometer, when we get Kilo-meters; no cabs running today, though."

Trains presented the same excuse.

"No trains," said the Megaphone Tosser, "until we reset 100,000 Mile-Stones, pardon me, I mean 'One-and-Six-Tenths of a Kilometer' Stones. No time Tables either, for the same reason."

The Tailor was mournful too. "No cloth at all," he advised. "All the old Yard-Wide Rolls at the Woolen Mills must be remade. Collars? Sure, but it is a 406 Millimeter not a 16 inch one now. And you must call your hat a 187 Millimeter, instead of a 7⅜."

In desperation, the Poor Chap sought to sell all that he had and move to Peaceful Fiume or Shantung.

"You own no Acres," objected the Real Estate Autocrat. "We can re-survey it next year, but your present deed is Nix, until Translated into the New Order of Units."

In a Hardware Store, he sought to buy an End-All-Here, but again he Failed.

"No guns left, Gentlemen," said the Weary Merchant to the Throng before the Counter. "No more guns until the new Bore can be adjusted. Plenty of Carbolic-Acid across the street; that is the one thing that was ready for this Metric-Foolishness."

Our Hero Drank, Staggered, and Awoke. It was not yet Day. He reached for the Button and Soft Light flooded the room. He stole quietly down to his Six-Best-Cellar.

"It is only a few Yards from my Acres down to the Office," he chuckled. "I will drink a Quart of Milk; then a Mile walk will do me good. I can live without Sugar, Cocktails, and Complaints, but this Metric Nonsense must be killed."

Spread out on the table at his Office lay the Wonderful Sunset Literature of the World Fade Klub. Without stirring more than 0.3048 of a meter, he threw the Trash into the Grate and watched with Satisfaction while it burned.

Never again would he fall for the Short Change

Artists, who promised a Metric Heaven and produced a Business Chaos.

MORAL: Give some folks "2.54 Centimeters" and they will take "1.6093 Kilometers." It is high time to voice your Protest to your Congressman regarding this Metric Bill now under consideration. A miss is as good as "1.6093 Kilometers" any day.

Spoiled Work and Its Prevention

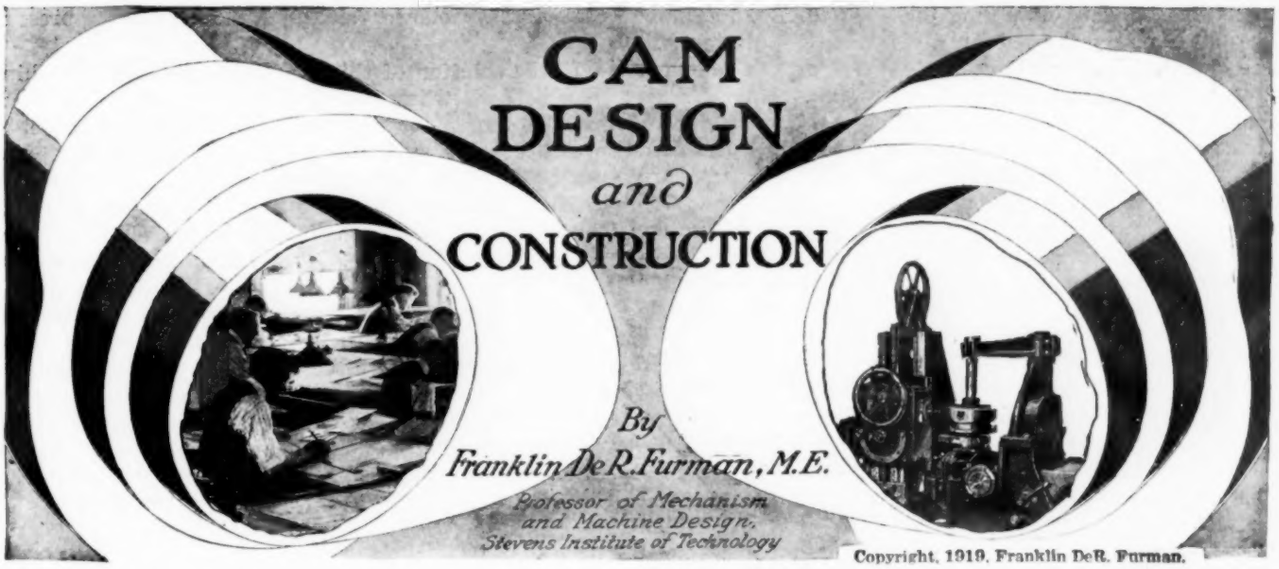
Herewith is a second table of percentages on defects in workmanship and material, and engineering. Upon investigation, we find that the percentage runs a little higher after deducting the assembling, painting and scraping hours.

Month 1919	Def. Workmanship	Def. Material	Eng. Errors
July	0.012	0.026	0.007
August	0.014	0.017	0.003
September	0.020	0.024	0.008
October	0.022	0.027	0.003
November	0.026	0.035	0.008
December	0.022	0.032	0.007

We thought this additional table might be of interest to you, as the table given you in our letter of Jan. 22, therefore, includes assembling, painting and scraping time.

JOHN GOETZ, Works Manager,
The Kempsmith Manufacturing Co.,
Milwaukee, Wis.

[The first table was published on page 637 of the current volume.—Editor.]



XI. Elliptical Arcs for Rolling Cams

The subject of pure rolling cam surfaces is further considered in this article. The simplicity of elliptical arcs for pure rolling cam arms is pointed out and the path of action, the angles of action for the two arms and the pressure angles are discussed. The same points are treated for parabolic and hyperbolic cam surfaces having pure rolling action, and in addition the adaptability of the parabola where the follower has rectilinear motion, and of the hyperbola where the camshafts are very close together, is explained. The true representation of cylindrical cam grooves is shown and the characteristic results obtained from using cylindrical, conical and hyperbolic follower pins in cylindrical cam grooves are pointed out. The involute cam is discussed and its special adaptability for some cases where the follower is offset and where there is sliding action between cam and follower surfaces is illustrated.

(*Part X was published in our April 8 issue.*)

CAM arms having pure rolling action may be constructed from arcs of ellipses as well as from the logarithmic curve, as described in the last installment. In constructing elliptical cam arms use is made of the characteristic of the ellipse that the sum of the two lines drawn from any point on the perimeter to the foci will be constant and will be equal to the length of the major axis. Briefly, then, it is only necessary as a first step to take two identical ellipses and center them on one pair of their foci at a distance apart equal to their major axis. Such a pair of ellipses, illustrated at *AC* and *BD* in Fig. 147, may be made to turn through 360 deg. respectively, and they will be in pure rolling contact all the time. If the shaft *B* is turning with uniform angular velocity the shaft *A* will turn with variable angular velocity and will go through 180 deg. while the shaft *B* turns through the angle *B'BB''*. Oscillating rolling arms may be obtained from the ellipses by simply taking equal and symmetrically placed arcs from each as shown at *EF* and *GH*, Fig. 147. The following problem will illustrate the method of construction.

Problem 32. Pure rolling elliptical cam arcs, angles of action equal.—Construct a pair of oscillating rolling cam arms whose working surfaces are arcs of ellipses. Take the distance between centers 24 units; make the angle of action of the driver and follower shafts the same, and find the pressure angle at any point.

In constructing problem 32, first lay down the assigned distances between centers, 24 units, as at *A* and

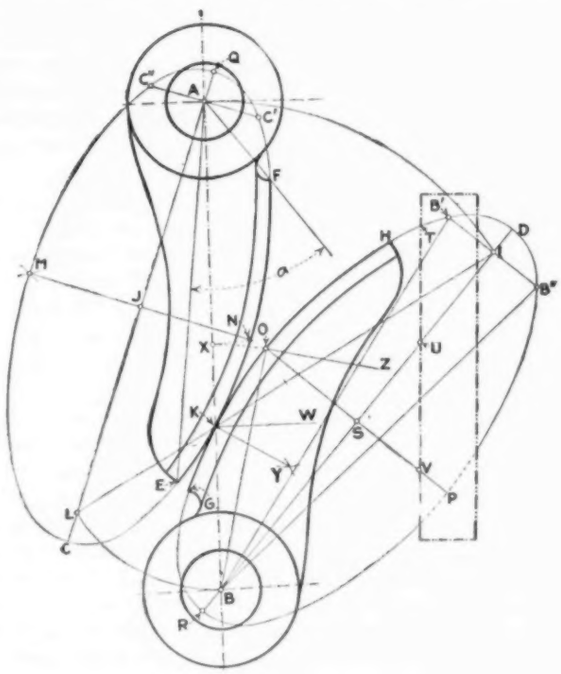


FIG. 147. BASIC ELLIPSES FOR PURE ROLLING CAM ARMS

B in Fig. 147. These points will lie at the fixed focus of each ellipse. Take any point, such as *K*, on the line of centers between *A* and *B*. The nearer *K* is taken to one of the foci the smaller will be the pressure angles between the rolling cam surfaces according to this construction, other data being the same. With *K* as a center and *KB* as a radius, draw an arc *BL* of any de-

sired length, thus obtaining the angle *BKL* which may be any value. The smaller it is taken the flatter will be the resulting working surface *GH* of the cam and the smaller will be the pressure angles. Had *K* been taken midway between *A* and *B* and had the angle *BKL* been made 90 deg. a limiting case would have resulted in which the ellipses from which the cam arms are taken would have had a minimum eccentricity and the cam arms would have had the largest angle of action, but the pressure angles would have been larger. With *K* as a center draw the arc *AI*, making angle *AKI* equal to *BKL*. Then *L* and *I* are the free foci of the basic ellipses.

To find the major and minor axes of the ellipses take *L* and *A*, Fig. 147, as centers and one-half of *AB* as a radius and draw short arcs intersecting at *M* and at *N*, as shown at *M*. Also use *B* and *I* as centers in the same way, thus obtaining *O* and *P*. *M* and *N* will then be the extremities of the minor axis of one ellipse and *O* and *P* the extremities of the other. From *J*, which is midway between *A* and *L*, lay off distances *JQ* and *JC* equal also to one-half of *AB*. *Q* and *C* are then the extremities of the major axis of one ellipse, and similarly *D* and *R* are the extremities for the other ellipse.

To find points of the ellipse take a piece of paper or a thin card having a perfectly straight edge as indicated by the dash and double-dot lines in Fig. 147. Mark the points *T* and *U* on the edge of the paper a distance apart equal to the semiminor axis *OS* and also mark the points *T* and *V* a distance apart equal to the semimajor axis *DS*. Then move the paper so as to keep the point *U* always on the major axis and *V* always on the minor axis, and the point *T* will move in the path of the desired ellipse.

To obtain an equal angle of action for both elliptical cams, as called for in the statement of the problem, equal lengths of arcs symmetrical about the extremity of the minor axis are taken from each ellipse. Thus *NE* equals *NF*, Fig. 147, and *OG* equals *OH* equals *NF*. The angle for each cam is then equal to *EAF*. This angle may be made larger or smaller by increasing or decreasing the arcs *NF* and *NE*. These arcs, however, should not approach too closely to the extremities of the major axis, for the pressure angle then increases rapidly, as for example when the contact point moves from *F* toward *Q*.

Pressure angle in rolling elliptical cam arms.—The pressure angle is the angle between the perpendicular to the radial line at the point of contact and the normal to the curve at that point. It varies at different phases and is a minimum when the extremities of the minor axes are in contact; that is when *N* and *O*, Fig. 147, come in contact at *X*. The angle *SOZ* is the pressure angle when *O* is in action. The line *OZ* is perpendicular to the radial line *BO*, and the line *OS* is normal to the curve at *O*. At *K* the angle *WKY* is the pressure angle. The normal to the ellipse at any point, such as *KY*, may be readily found by making use of the property of the ellipse that the normal to the curve at any point is the bisector of the angle formed by the focal lines from that point. For example, *KB* and *KI* are focal lines from *K*, and *KY* bisects the angle *BKI*.

Problem 33. Elliptical rolling cam arcs, angles of action unequal.—Construct a pair of oscillating rolling cam arms whose working surfaces are composed of an arc of an ellipse. Take the distance between centers 24 units, make the angle of action of the driver 2.9 times that of the follower and find the maximum pressure angle.

In the solution of this particular problem any ellipse may be used whose major axis is 24 units long. The shorter the minor axis is taken the less will be the pressure angle, and the smaller also will be the actual practical angles through which the cam arms will swing. In laying down the problem take *QC*, Fig. 148, equal 24 units, as the major axis of the ellipse. Bisect *QC* at *X* and assume *XM* and *XN* as the semiminor axes. With *M* and *N* as centers and a radius equal to *QX* draw short arcs intersecting the major axis at *A* and at *L*. These points will be the foci of the ellipse. Construct the ellipse as directed in the previous problem. Select an arc of such length and position on the ellipse that it will subtend focal angles, *i.e.*, angles whose vertices are at the foci, which are to each other as 1 is to 2.9. Such an arc is shown at *FE* and it subtends an

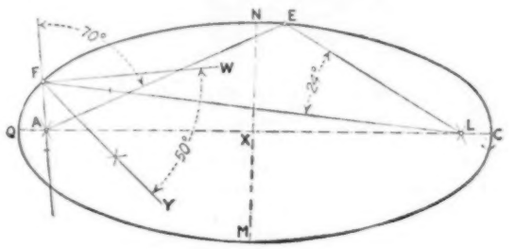


FIG. 148

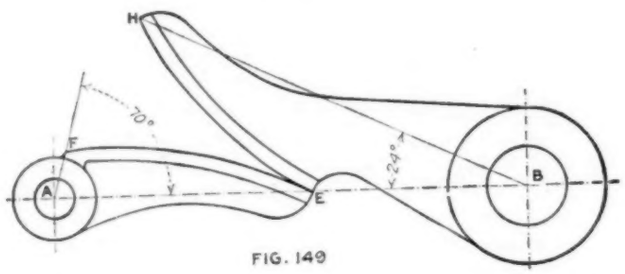


FIG. 149

FIG. 148. ANGLES OF ACTION FOR ELLIPTICAL CAM ARMS
FIG. 149. PURE ROLLING ELLIPTICAL CAM ARMS

angle of 24 deg. from the vertex at *L*, and an angle of 70 deg. from the vertex at *A*. The value of 2.9 given in the data is now provided for because 70 divided by 24 equals 2.9. The arc *FE* is used for the form of the working surface of the two cam arms, as directed in the following paragraph:

To construct the cam arms for problem 33 lay down the shaft centers by marking the points *A* and *B*, Fig. 149, 24 units apart. On a piece of tracing paper draw the arc *FE* of Fig. 148 and mark the point *A*. Lay the tracing paper down in Fig. 149 with *A* of the tracing at *A* of the figure and with *E* of the tracing on the center line *AB*. Redraw the traced curve in Fig. 149, giving *EF*. Again on the tracing paper draw the curve *FE* of Fig. 148 and mark the point *L*. Lay the tracing paper down in Fig. 149 with *L* of the tracing at *B*, and *E* of tracing on the center line *AB*. Redraw the traced curve in Fig. 149, giving *EH*. *EF* and *EH* should be tangent at *E* if the work is correctly done. The forms of the arms and the hubs are now drawn and the angles of 70 deg. and 24 deg. are indicated as shown in Fig. 149, thus giving a ratio of turning angles of 2.9 to 1 as required. The maximum pressure angle will be at the point on the working curve that is nearest to the extremity of the major axis of the

original ellipse, and it will be equal to 50 deg. as shown at *WFY*, Fig. 148.

Rolling parabolic cam surfaces for a reciprocating motion.—The parabola lends itself to pure rolling action in cam work, but it can be used only when either the driver or the follower has rectilinear motion, and then the rectilinear motion must be in a direction perpendicular to the line of axes of the two parabolas when they are in contact at their vertices.

Problem in rolling parabolas.—Required a parabolic oscillating cam to give rectilinear motion to the follower with pure rolling action. Assume the length of contact and find (a) angle of action of driver, (b) range of motion of follower and (c) the maximum and minimum pressure angles.

Construct a parabola by making use of the property that a point on the curve is equidistant from the focus and the directrix. To do this assume a point *A*, Fig. 150, as the focus of the parabola on the line *XX* as an axis. Assume the directrix *YY* at right angles to the

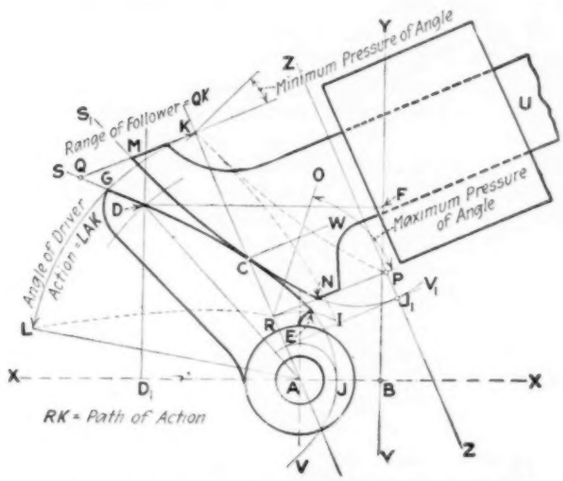


FIG. 150. PARABOLIC CAM SURFACES FOR PURE ROLLING RECIPROCATING MOTION

axis and at any desired distance *AB* from the focus. The larger *AB* is taken the larger will be the oscillating cam for a given motion and the smaller will be the pressure angles. The vertex of the parabola will be at *J* midway between *A* and *B*. A point on the curve may be found by assuming any radius, such as *AD*, and drawing a short arc as shown at *D*, using *A* as a center; then laying off this radial distance on the axis starting from the directrix as at BD_1 and drawing a perpendicular line D_1D until it meets the arc at *D*. The point *D* thus obtained will then be a point on the parabola and other points may be found in the same way and the curve *SJV* drawn. Draw a radial line *AK* perpendicular to the desired direction of motion of the follower, which direction in this problem is *CW*. On this radial line assume any distance *RK* as the path of action; then arcs of circles through *R* and *K* having *A* for a center will limit the part *GE* of the parabolic curve which will form the driver-cam surface. The entire oscillating cam *GEA* may now be drawn.

The surface *MN* on the follower arm, Fig. 150, will be identical with *GE*, already constructed, and may be readily found by drawing the lines *SJV* and *XX* on a piece of tracing cloth or paper, turning the paper on the reverse side and then adjusting it, always keeping *XX* of the tracing parallel to *AK*, until the two curves come tangent as shown at *C*. The axis *XX* of the tracing will then be in the position *ZZ*. The follower cam surface and rod *MNU* may now be drawn. The angle of action, range of action and pressure angles may now be found as indicated in Fig. 150. The two parabolic surfaces *GE* and *MN*, Fig. 150, will be in pure rolling action on the path *KR*, the driving cam turning about *A* and the follower cam moving in a direction perpendicular to *KA*.

Rolling hyperbolic cams.—Two equal hyperbolas will give pure rolling action to two oscillating cam arms, the essential features of construction being that the hyperbolas should turn about one pair of foci as fixed centers and that the distance between these centers should equal the distance between the vertices of the hyperbolas. In Fig. 151 *A* and *B* are the foci of one hyperbola and *CO* and *DU* its two branches, while *H* and *S* are the foci of the other hyperbola and *VW* one of its branches.

Problem in rolling hyperbolas.—As a problem illustrating the application of hyperbolas to rolling-cam work let it be required to construct two cam arms and shafts and determine the angle of action of each and the maximum and minimum pressure angles.

Construct the hyperbolas by making use of the property that the distances from any point on the curve to two fixed points, called the foci, have a common difference. Therefore, assuming *A* and *B* as foci, Fig. 151, and *C* as a vertex the common difference to be used throughout will be *CB* minus *CA*, equals *CD*. By assuming different distances between *A* and *B*, and *A* and *C*, different angles of action and different pressure angles will be obtained.

A point on the hyperbola, such as *E*, Fig. 151, is found by taking any radius such as *BE* and striking an arc with *B* as a center. Then with *A* as a center draw another short arc with a radius equal to *BE* minus *CD*. Where the second arc crosses the first will be a point on the curve as at *E*. Other points are found in the same way.

The center of one shaft will be located at the focus *B* if it is desired, for example, to show the cam surfaces in contact on the branch *CO*. Assuming *E* as the point of tangency of the two cam surfaces, the center of the other shaft, and consequently one focus of the other hyperbola, must be on the line *EB*, for the reason that in pure rolling action the point of contact must always be on the line of centers.

The second hyperbola must be placed with respect to the first so that the distances between the fixed foci and the free foci are equal to each other and to the distance between the vertices of the hyperbola. Therefore, take the distance *CD* and lay it off at *BH*; also use it as a radius with *A* as a center to draw the short arc through *S*. With *H* as a center and *AB* as a radius draw another arc intersecting the first at *S*, thus determining the second focus *S* of the second hyperbola and its axis if it is desired. The tangent branch *VW* may now be independently constructed as explained for *CO*, or it may be traced from *CO* of which it is a duplicate.

The path of action, assuming *KG* to be the driving-cam surface, the angles of action for both camshafts and the maximum and minimum pressure angles may be obtained from a study of the illustration in Fig. 151.

Detail drawing of cylindrical cams.—A simple practical method for constructing the surface guide line for

the center of the cutting tool in cylindrical cams was explained in article VIII. A more elaborate method of construction giving a more precise mechanical action and a more complete drawing of the cam is now given.

To find the true maximum pressure angle of a cylinder cam the pitch cylinder and not the surface cylinder should be drawn first. The pitch cylinder is shown at

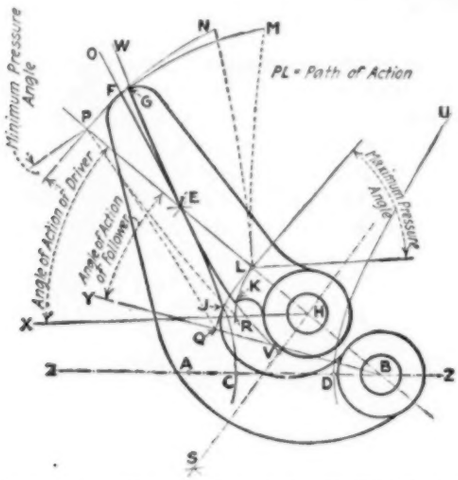


FIG. 151. HYPERBOLIC CAM SURFACES FOR SWINGING ARMS ON CLOSE CENTERS WITH PURE ROLLING ACTION

B', W', $H_3 \ldots Q_3$, etc., Fig. 152, and is drawn with a radius of 5.2, the data, excepting for pressure angle and method of construction, being the same as for problem 15. Briefly, the data are: (a) Follower to move in a straight line four units to the right on the crank curve while the cam turns 120 deg.; (b) to move to left four units on crank curve while cam turns 120 deg.; (c) to dwell while cam turns 120 deg.

The pitch curve Q_2P_2J, etc., is then obtained and the normal JG_1 is drawn as in problem 15. This normal will make an angle of 30 deg. with JD if the work is correctly done. This is the assigned maximum pressure angle and is at the bottom of the pin; the pressure angle DJG at the surface of the cylinder will be less than 30 deg. In this problem the data and layout were such that the point J of maximum pressure angle could be readily made to fall on the front element of the cylinder and the angle DJG_1 thus shown in its true size. Where the data and layout are such as not to conveniently bring the pitch point on the front element of the cylinder the pitch curve will have to be revolved if it is desired accurately to show the pressure angle in true size on the drawing.

Drawing of groove outlines for cylindrical cam.—If it is desired to draw the groove outlines of a cylindrical cam one of two methods may be used; (1) the approximate method or (2) a more exact method. The approximate method, which is simpler and quicker and which gives good-appearing results where the slope of the groove does not exceed 30 deg., is applied by laying off the points *1* and *2*, Fig. 152, at equal distances on each side of H_3 on the surface pitch curve, these points representing the extremities of a diameter of the follower pin. Similarly, the points *3-4*, *5-6*, etc., are obtained. A curve drawn through the points *S*, *1*, *3*, *5*, etc., will represent one of the surface edges of the groove. The bottom lines of the groove are found, for example, by projecting J_3 to J_4 and then laying out the diametral line *9-10*. A curve through *9* and other similarly found points will represent one of the bottom edges and the curve through *10*, etc., will represent the other.

A more exact method of drawing the outlines of the groove consists in drawing the projection of a section of the pin which is tangent to the cylinder. The section will appear in general as an ellipse in the side view and the curves representing the groove edges will be drawn tangent to these ellipses instead of through the extremities of the major axes as described in the preceding paragraph. The detail work for this is shown in Fig. 152, where the straight line *7'-8'* is the end projection of a pin section which is tangent to the cylinder. The points *7* and *8* are projected from *7'* and *8'* and are the extremities of the minor axis of the ellipse; the horizontal line *5-6* passing through J, is equal to the diameter of the pin and is equal to the major axis. J_3 is projected from J'. The ellipse *5*, *7*, *6*, *8*, is now constructed as shown. Similar ellipses should be constructed at other points as at I_3, H_3, etc. At A the ellipse becomes a circle and at E it flattens to a straight line. The curve SE_4 drawn tangent to the ellipses instead of through the extremities of the major axes will be one of the surface edges of the groove. Even with this refined method of construction there remains an approximation, for it will be evident that the circle at the top of the pin lies in a plane which is tangent to the cylinder and that the projection of this circle gives an ellipse that does not lie on the surface of the cylinder. Therefore, the curve drawn tangent to the ellipse would not lie on the cylinder. The error, however, in following the above directions is too small to show in a drawing of practical proportions. If desired this slight error in construction may be corrected by rounding off the end of the pin to conform with the curve of the cylinder and projecting the curve

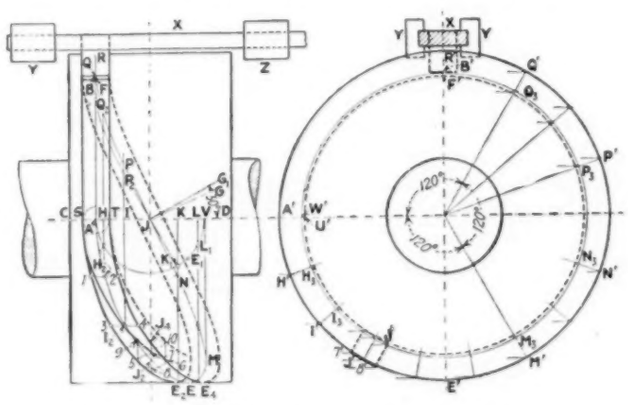


FIG. 152. CYLINDRICAL CAM, SHOWING TRUE PITCH CYLINDER AND TRUE PRESSURE ANGLE; ALSO METHODS OF CONSTRUCTING GROOVE OUTLINES

of the rounded end of the pin to the side view to give the elliptical-like curve to which the groove curve is tangent. This is illustrated in a case of exaggerated proportions in Fig. 153 where M is a true ellipse and is a projection of the end of the pin when it is flat. N is a projection of the perimeter of the pin when its end is rounded off to conform with the curve of the cylinder.

Forms of follower pins for cylindrical cams.—Cylinders, cones and hyperboloids may be used for the form of follower pins to work in the groove of cylindrical cams.

A cylindrical pin drawn to a large scale is shown at *GJ*, in Fig. 153, lying in a groove which is cut in the cam cylinder *CZ*. The cylindrical pin is advanced longitudinally the distance *EF*, Fig. 153, while the cam turns through the angle A_1OA_2, Fig. 154. The top edges of the groove are represented by the helical curves GG_4 and HH_4, Fig. 153, and the bottom lines of the working-side surface of the groove are represented by II_4 and JJ_4. The center of the follower pin is shown in its central position at A_2. The straight line A_2G_2 is a normal to the top pitch line AA_2A_4 of the groove, and it is the line of pressure between the side of the groove and the follower pin at the surface of the cylinder. The angle KA_2O is the pressure angle at the top of the pin and it is made 30 deg. in this example, as shown in Fig. 153. The straight line A_2I_2 is a normal to the helix BA_2B_4, which is the locus of the center point of the bottom of the follower pin. The line A_2I_2 then is the line of pressure between the side of the groove and the pin at the bottom of the pin, and LA_2O is the pressure angle at the bottom of the pin. The pressure angle therefore varies from the top to the bottom of the groove, being smallest at the top. From this it follows that the pitch surface of a cylindrical cam should be at the shortest radius reached by the follower pin rather than at the outer surface where it is usually taken, provided it is desired not to exceed a given maximum pressure angle on the follower pin.

When the pin is moving, the line of contact between the side of the groove and the side of a cylindrical pin is a curved line, and one phase is shown in end projection at G_2I_2, in Fig. 153, and in side projection at G_1I_1, in Fig. 154. When the pin is not working it has straight-line contact with the side of the groove, as shown at *GI* in Fig. 153. If the follower pin is fixed in the frame that carries it, it will receive wear on the forward stroke entirely within the area GG_4I_4IG, Fig. 153. G_4 is the same horizontal distance from the vertical center line through A as G_2 is from the vertical center line through A_2.

A rotating cylindrical pin cannot have pure rolling action against the side of the groove in a cylindrical cam, for such action requires at least that two rolling curves must measure off their lengths equally on each other. This means that if the circumference of the follower pin at the top goes a certain number of times in the curve GG_2G_4, Fig. 153, the circumference at the bottom must go the same number of times into the curve II_2I_4. This of course cannot happen with a cylindrical pin, for the circumferences of the pin are the same top and bottom, while the helical curves at the top and bottom of the groove against which they operate are totally different in length. From the above it follows that there will be considerable sliding between a cylindrical pin and cylindrical cam and that this will be greater the greater the length of the pin.

A conical follower pin for a cylindrical cam is shown at M_1R_1, in Fig. 154, and in end view in Fig. 155. In the latter view the line GG_1 is tangent to the helix which marks the center of the top of the groove, and A_2G_2 is normal to it, giving the point G_2 at which the conical pin is tangent to the side of the groove at the outer circumference. The conical pin is here taken the same size at the top as the cylindrical pin in Fig. 153 and consequently the line A_2G_2, in Fig. 155, will be parallel and equal to the line A_2G_2 in Fig. 153. Likewise I_2 Fig. 155, is the point of tangency at the inner end of the pin. These points of tangency and intermediate ones will determine the line of contact G_2I_2 between the conical pin and the side of the groove for the position shown. This line is also shown in side projection at G_1I_1 in Fig. 154. If the pin is rigidly attached to the follower framework the wear on the pin will fall on the area represented by the surface $S_1S_2I_2G_2$. If the pin is free to turn on its axis it will come nearest to having rolling action when the circumference at the bottom of the conical pin is to the circumference at the top as the length of the helix BB_4 is to the helix AA in Fig. 153, or, when the conical vertex of the roller is at O_1, Fig. 154, on the center line of the cylinder. Conical pins give thrust in an axial direction, and consequently there must be special pro-

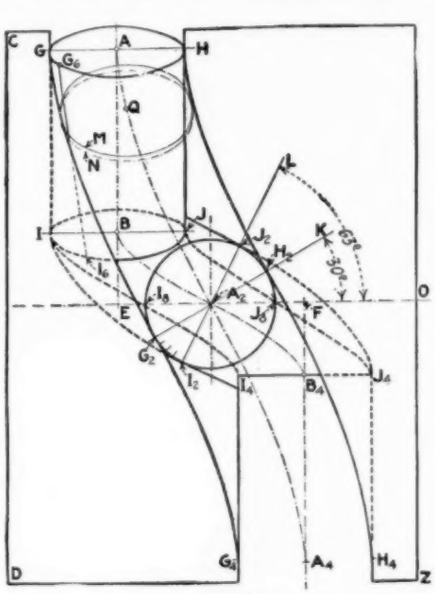


FIG. 153

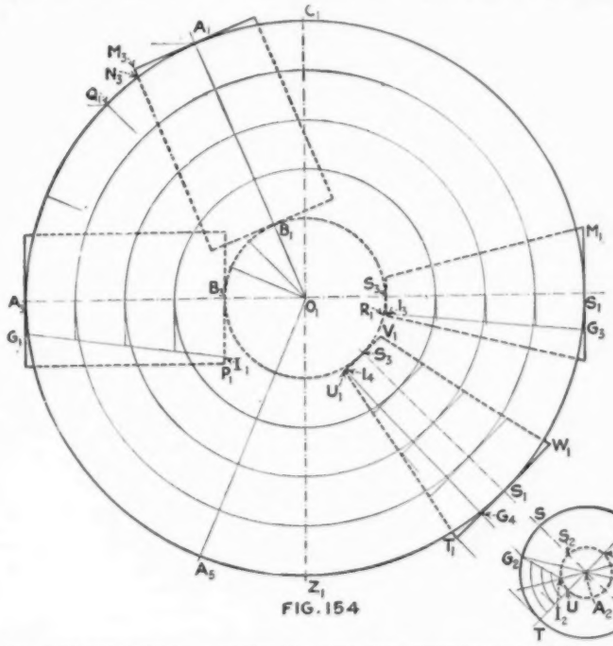


FIG. 154

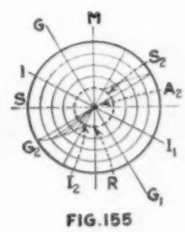


FIG. 155

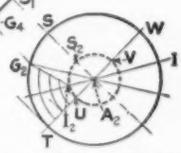


FIG. 156

FIGS. 153 TO 156. SHOWING USE OF CYLINDRICAL, CONICAL AND HYPERBOLIC FOLLOWER PINS IN CYLINDRICAL CAM GROOVES

vision in the follower framework for holding the pin in place. Conical pins have a natural advantage in that they may be designed to move in axially so as to take up wear in the pin and in the groove.

A hyperboloidal follower pin is shown at $T_1U_1V_1W_1$ Fig. 154, and in end view in Fig. 156. In the latter figure the lines A_2G_2 and A_2I_2 are perpendiculars to the top and bottom helices of the groove respectively, the same as the similarly lettered lines in Fig. 153. If the diameters T_1W_1 and U_1V_1 are taken in the same ratio to each other as the lengths of the top and bottom helices of the groove in which the pin rolls, the closest approximation to rolling action will be obtained. There cannot be pure rolling of the hyperboloidal pin, however, on the side of the groove, for even where the circular sections of a hyperboloidal pin measure themselves off equally on the corresponding helices on the surface against which they roll, there is always an inherent fundamental endwise or longitudinal component of sliding in the direction of the axis of the pin in every hyperboloidal action. The nature and amount of this characteristic is explained in some of the books on descriptive geometry.

To lay out the hyperboloidal pin the lines A_2G_2 and A_2I_2, Fig. 156, and the circles TW and UV are drawn. The straight line from G_2 to I_2 is drawn and used as the generatrix of the hyperboloid, the outline of which is the curved line T_1U_1, Fig. 154. Points on this curve are found by dividing G_2I_2, Fig. 156, into, say, four equal parts, revolving the dividing points to the line TU and then projecting them to the equally spaced lines which are drawn from S_1 to S_2, Fig. 154. The straight line G_1I_1 will be the line of contact between the pin and the groove at the maximum pressure angle, and the curved hyperboloidal line S_1S_2 the line of contact at the end of the stroke. The wear on a pin fixed in the follower frame would occur on the hyperboloidal surface between these two lines.

Involute cam.—The involute curve may be used for cam outlines. It gives characteristic motion almost identical with the cam having a straight-line base curve, but it is not so simple to construct. The involute cam will not give true motion to a roller follower unless the ends of the cam-working surface are eased off, as they are in the straight-line combination cam or the logarithmic combination cam by arcs of circles or other curves. For the same data as were taken for comparison of cams shown in Figs. 84 to 135, Article IX, the involute curve gives a slightly larger cam than does the straight-line base curve, the maximum radius in each case being 2.78 and 2.65 respectively. The method of finding the maximum radius for the involute cam will be explained in the next problem.

The involute is popularly defined as the curve that would be generated by a point on a string which is being unwound from the periphery of a circular disk, the string always being kept taut and always in the same plane.

The involute is readily constructed, according to the preceding definition, by drawing a circle of any size, as illustrated at *SPR*, Fig. 157, taking any point as *S* as the origin of the involute; laying off a series of equal angles of any desired unit, as at *SOM*, *MON*, etc.; drawing tangents to the circle at *M*, *N*, etc., and making the lengths *MY*, *NU* of the tangents equal, successively, to the lengths of the arcs *MS*, *NS*, etc. This latter operation may be done graphically by setting the small dividers to a step of ¼ in. or less, starting at *S* and counting the steps toward *M* until *M* is reached or passed, and then counting off the same number of steps in the reverse direction going along the tangent line, thus obtaining the point *Y* on the involute curve. This graphical method of stepping off distances, while accurate in theory, is apt to give an appreciable cumulative error, and therefore should be checked by a simple computation as follows: Length of tangent *NU*, for example, equals length of arc *NS*, equals $\frac{OS \times 2 \times 3.14 \times \text{angle } NOS \text{ in degrees}}{360}$. In general it is advisable to first compute and draw a long tangential line as *RW* at 180 deg. from *S*, and then if six equally spaced construction points are used as at *M*, *N*, etc., to make the tangent *PV* one-half of *RW;* the tangent at *MY*, one-third of *PV;* the tangent at *NU*, two-thirds of *PV*, etc.

Pressure angle with involute cam.—Pressure angle is defined as the angle made by the line of action of the follower and the normal to the pitch curve of the cam. Therefore if the follower moves in the direction *OV*, Fig. 157, and if the normal to the involute at the point *V* is *VH* the pressure angle is *HVK*. The angle *HVK* grows smaller as the point *V* is moved to the right toward *W*, and larger as it is moved to the left toward the origin of the curve at *S*. At *S* the pressure angle would be 90 deg. because the involute is tangent to the line of action *OS* of the follower. The line of action of the follower is a radial line in the type of cam being considered in this problem. From the above it may be seen that there are a series of points on the involute where there are definite pressure angles, and these points will be noted here, as they are necessary in solving a specific problem.

At *E*, Fig. 158, the pressure angle is 20 deg. The point *E* is obtained by laying off an angle of 88 deg. from the origin of the curve, as at *SOE*. The other points for pressure angles of 30 deg., 40 deg., etc., are found at *A*, *D*, etc., by using the values given in the following table. The method of finding these values will be given in a later paragraph for those who may be interested.

	Deg.	Deg.	Deg.	Deg.	Deg.
Pressure angle	20	30	40	50	60
Initial angle	88	39½	18	8	3

Problem. Required an involute cam that will move a radial follower one unit while the cam turns 60 deg. with a maximum pressure of 30 deg.—To solve this and any other similar involute cam problem it is necessary to construct first an accurate basic involute curve of any convenient size as directed in the preceding paragraphs; then to lay off the initial angle corresponding to the given pressure angle in the problem. In this problem the pressure angle is given as 30 deg. for which the initial angle is 39½ deg., as determined from the table, and this latter angle is laid off at *SOA*, Fig. 157, where the basic curve has been drawn. From *OA* lay off the given working angle of 60 deg. as at *AOF*. Draw the circular arc *AG* and measure the distance *GF*. Then make a proportion in which the distance *GF* is to the assigned follower motion as the radius *OA* is to the desired shortest radius of the pitch surface of the cam. In this problem *GF* measures 1.12 units, the assigned follower motion is 1 unit, and the radius *AO* = 2.00 units. Therefore,

$$1.12 : 1.00 : : 2.00 : x \text{ or}$$
$$x = 1.78$$

equals the shortest pitch radius of the cam. With this value known, it is a simple matter to draw the required involute cam as in Fig. 159, where OA equals x, as just computated, HAK equals the pressure angle of 30 deg., and the line HA extended is tangent to the base circle EQ, which is necessary in the drawing of the desired involute. With these items laid down the involute pitch surface from A to F is constructed in detail as described above in the paragraph devoted to the construction of the involute, and briefly, in review, as follows:

Lay off the assigned working angle of 60 deg. as at AOF. Make OF equal to AO plus the assigned motion of the follower, which is one unit in this problem. Draw FQ tangent to the base circle. Draw the radial line FTO and divide the arc TQ as at I and J into a convenient number of equal parts, three being taken in this illustration. Draw tangents at I and J. Step off the distance ATI on II_1, thus obtaining I_1, etc. Draw the involute curve through A, I_1, J_1, F, thus obtaining the involute pitch surface of the cam. The working surface, if a roller is used, is found by taking the radius of the roller and drawing a series of arcs with I_1, J_1, etc., as centers and drawing a curve tangent to them as at I_2, J_2, etc. It will be observed that a working curve so drawn will be tangent to the last construction arc at Q_2 on one side of the cam lobe and tangent at Q_4 on the other side, giving the actual tip of the working-cam surface at Q_3. This means that if the roller follower is to move with a velocity characteristic of the involute curve that its ultimate stroke will be less than the desired amount by the distance Q_3Q_4. This can only be corrected when a roller follower is used by disregarding the involute characteristics at the end of the stroke and by arbitrarily changing the true working-surface curve from J_2 to Q_2 so that the curve will run smoothly from J_2 to Q_3.

The involute curve has a fixed initial angle for each pressure angle.—For example, the initial angle SOA, Fig. 158, will always be 39½ deg. for a maximum pressure angle of 30 deg., no matter what size of involute is used. This may be readily shown as follows: Let y equal the angle SOA, which is the initial angle from the origin of the involute to the point where the pressure angle is to be shown. Let a be the assigned pressure angle as represented at HAK. Then the angle $SOT = y + (90 \text{ deg.} - a \text{ deg.})$. Let x equal OT, the radius of the base circle of the involute. Then

$$x \cot a = AT = \text{arc } ST = 2\,x\pi\,\frac{y + 90 - a}{360}.$$

The value of x cancels, and for a pressure angle of 30 deg. substituted for a, y is found to be 39½ deg. Similarly, the initial angle is found to be 18 deg. for a pressure angle of 40 deg., etc.

Involute specially adapted for a flat-surface follower.—The involute curve is naturally adapted for an oscillating-cam surface where a flat-surface follower is used, and in this case it gives a uniform linear velocity

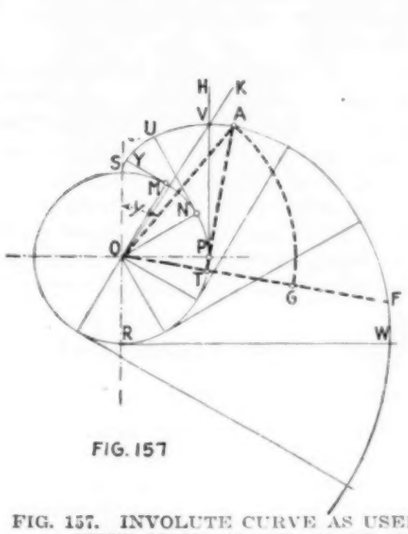


FIG. 157

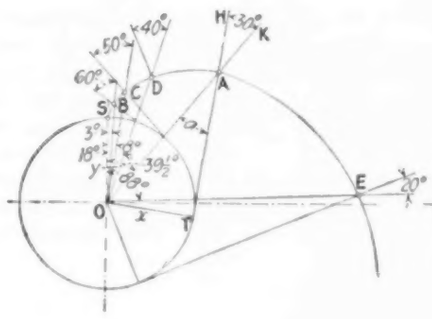


FIG. 158

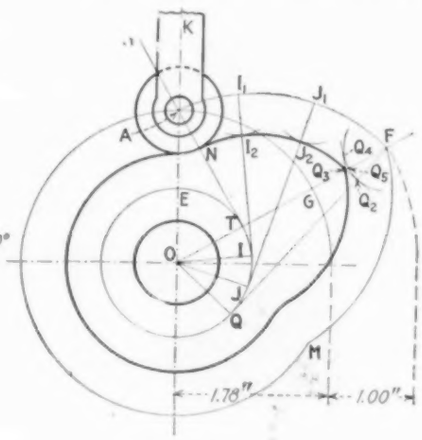


FIG. 159

FIG. 157. INVOLUTE CURVE AS USED, SPECIFICALLY IN CAM CONSTRUCTION. FIG. 158. SHOWING THAT ALL SIZES OF INVOLUTES HAVE THE SAME INITIAL ANGLE FOR EACH PRESSURE ANGLE. FIG. 159. INVOLUTE CAM FOR RADIAL FOLLOWER BASED ON THE SPECIFIC DATA IN ACCOMPANYING PROBLEM

to the follower. The natural advantage of an involute cam for a flat-surface follower, shown in Fig. 160, is based on the property of an involute that the tangent XY to the base circle RQ is normal to the involute as at Y, and consequently that the perpendicular line at TZ is tangent to the involute. Therefore TU may represent the flat surface of a follower collar attached to the follower rod SS'. T_1U is the follower in its highest

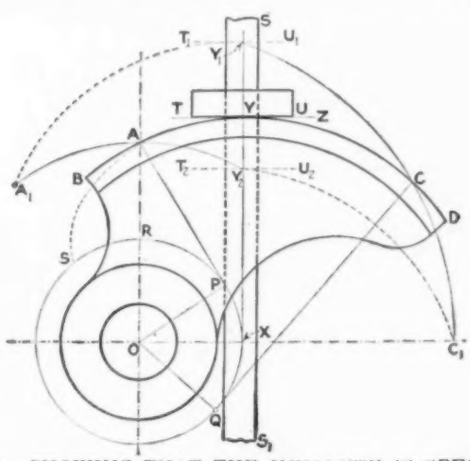


FIG. 160. SHOWING THAT THE INVOLUTE IS SPECIALLY ADAPTED FOR AN OFFSET FLAT SURFACE FOLLOWER

position and T_2U_2 in its lowest position considering that only the part AC of the cam surface is used. An involute curve cam as from A to C would always be tangent to the flat surface of the follower and the line of contact between cam and collar would pass

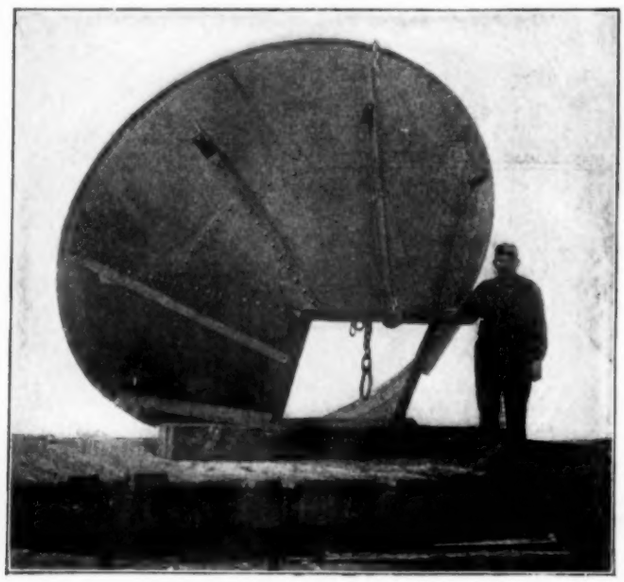
through the center of the follower rod, moving up and down between Y_2 and Y_1. This means that there is no pressure angle on the follower rod except that due to friction.

This last feature of the involute cam gives it perhaps its greatest practical importance. Where it is desired to give the follower a definite velocity and acceleration between its extreme points of travel, Y_2Y_1, the involute cannot be used.

A Heavy Hand "Forging"

By Milton Wright

As an illustration of what may be done without special equipment the large hopper, shown on the flat car in the photograph, is presented.



A LARGE HAND "FORGING"

The piece is about 12 ft. in diameter at the large end, 7 ft. high, and the smaller opening is 2½ ft. square. It is made of ⅜-in. iron plate and is all hand work for the reason that the shop where it was made in answer to a hurry call is not equipped with plate bending rolls or other devices for shaping the plates.

However, shears, punches, portable drilling machines and riveters were all available but the forming and bending was all done by hand with sledges and hammers. Fires were built on the ground wherever it was handy and sometimes inside the cone as the work progressed.

In spite of the fact that no bending rolls were to be had, the work was accomplished in a very short time. The boss blacksmith whose handiwork it is, is shown standing beside the finished cone.

Enlarging an Automobile Piston

By Walter Cantelo

On page 548 of the *American Machinist* is an article entitled "Enlarging Automobile Pistons" in which the writer apparently gives all the credit for the increased diameter of the piston to the effect of the blows of the hammer. I am of the opinion from past experience that the increased diameter resulted more from the thorough heating and cooling than it did from the hammering. In a number of instances I have had castings that were too small to clean up in machining and have saved them from the scrap heap by heating and cooling them several times until they were expanded to a sufficient amount.

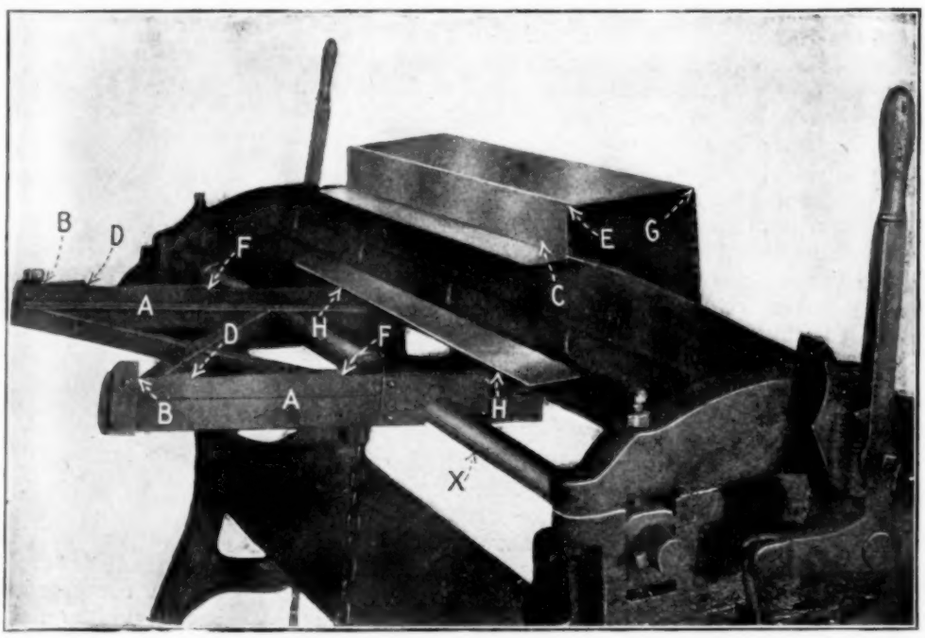
If Mr. Starr still has the old pistons I would suggest that he put them through a series of heating and cooling operations, making careful measurements of the diameter and length of each piston before commencing each heating and recording same. Also, if possible, note temperature of pistons when heated and ready to remove from furnace. I think he will be surprised at the expansions that will occur and the results of such an experiment would be interesting reading for all of us.

Forming Tanks on a Hand Brake

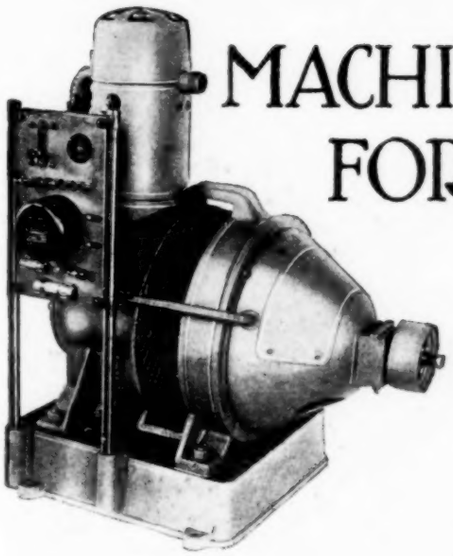
By Frank C. Hudson

The method shown enabled a standard hand brake to replace an expensive forming fixture and is much more easily operated and more satisfactory in every way.

The guides *A* hook over the rod *X* of the machine and along the guides the metal sheet is laid with its edge against the stop *BB*. In this position, the brake makes the short bend *C* at the other end of the piece. The sheet is then turned over, the straight-edge placed against the stop *DD* and the bend *E* is formed. The sheet is then held against the stops *FF* which makes the next bend *G*. The last is made with the sheet stopped at *HH* as shown, and it requires but little practice to form these tanks rapidly and accurately.



FORMING A GAS TANK



MACHINING THE GAS ENGINE FOR A LIGHTING UNIT

J. V. HUNTER
Western Editor, *American Machinist*

II. Miscellaneous Operations

Many of the miscellaneous operations in connection with the manufacture of a gas engine for a small self-contained lighting unit are covered by this article. Like the operation described in the previous article, many of these are performed on turret lathes.

(Part I was published in our April 8th issue.)

THE main foundation base casting for the lighting unit serves as a chamber for the storage of the kerosene-engine fuel. Little machine work is done on this casting other than a small amount of drilling, and the milling on the top surface of certain bosses which are left as bearing points for the motor and the generator. A heavy knee-type Ingersoll milling machine is used for this operation, Fig. 8, and is equipped with a large inserted-tooth milling cutter which is fitted with stellite blades.

The camshaft bearing is drilled and reamed under a radial drilling machine, Fig. 9, using the jig *A*, whose centering plug fits into the main bearing. Afterward the base and the feet are milled off and they are then drilled for bolting to the foundation casting.

The cylinder heads are faced and partly drilled in a Gisholt turret lathe, and Fig. 10 shows the set-up of tools required for this operation. The method of chucking the cylinder-head castings is interesting, because long extension jaws *A*, Fig. 11, are required on account of the bosses and stud projections on top of this casting. These jaws grip on the radiation flanges and care is required to avoid putting so much strain on these that they might be injured or broken. The additional supporting studs or brackets *B* and *C* will be noted extending from the face of the chuck plate.

The crank-case cover, Fig. 12, is another turret-lathe job. The hub of this is turned, bored, reamed and faced, and the outside bearing rim is faced as shown on the finished casting *A*.

The pistons are completed in two series of operations; the first of which turns about one-half of the crank end, cleans the flange and chamfers off the inside corner. For the second series of operations on this part the piston is chucked from the other end and the cylinder end of the body is turned, faced and centered while

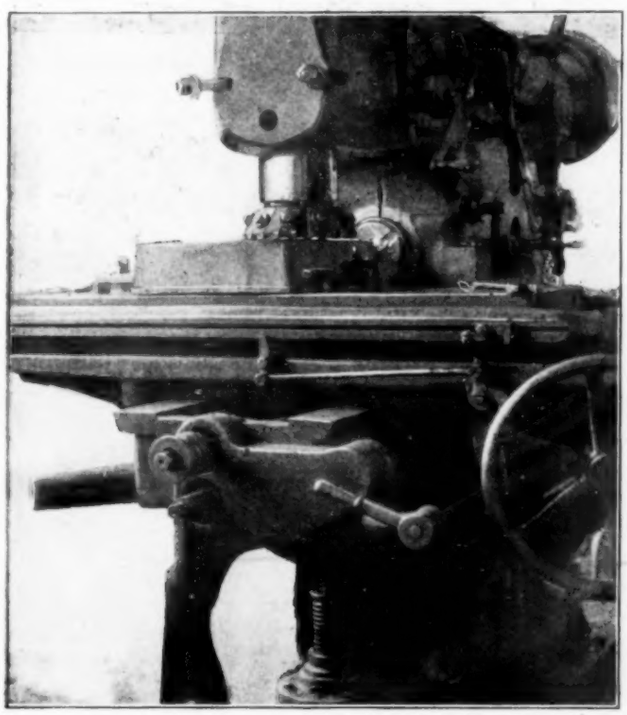


FIG. 8. MILLING TOP FACE OF FOUNDATION CASTING

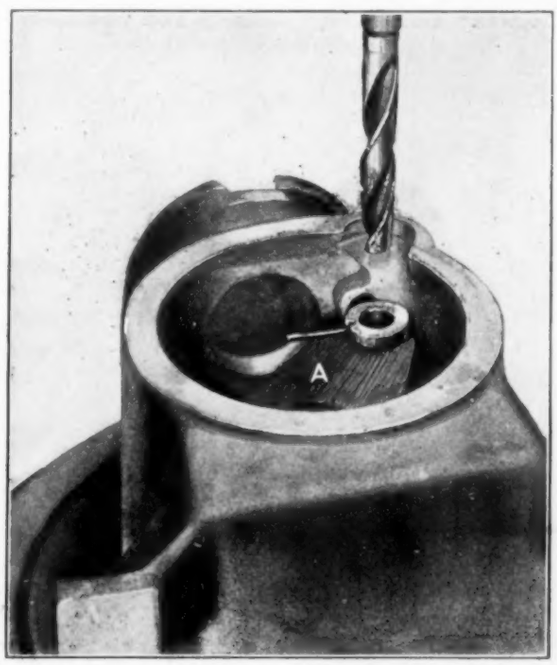


FIG. 9. DRILLING CAMSHAFT BEARING IN CRANKCASE

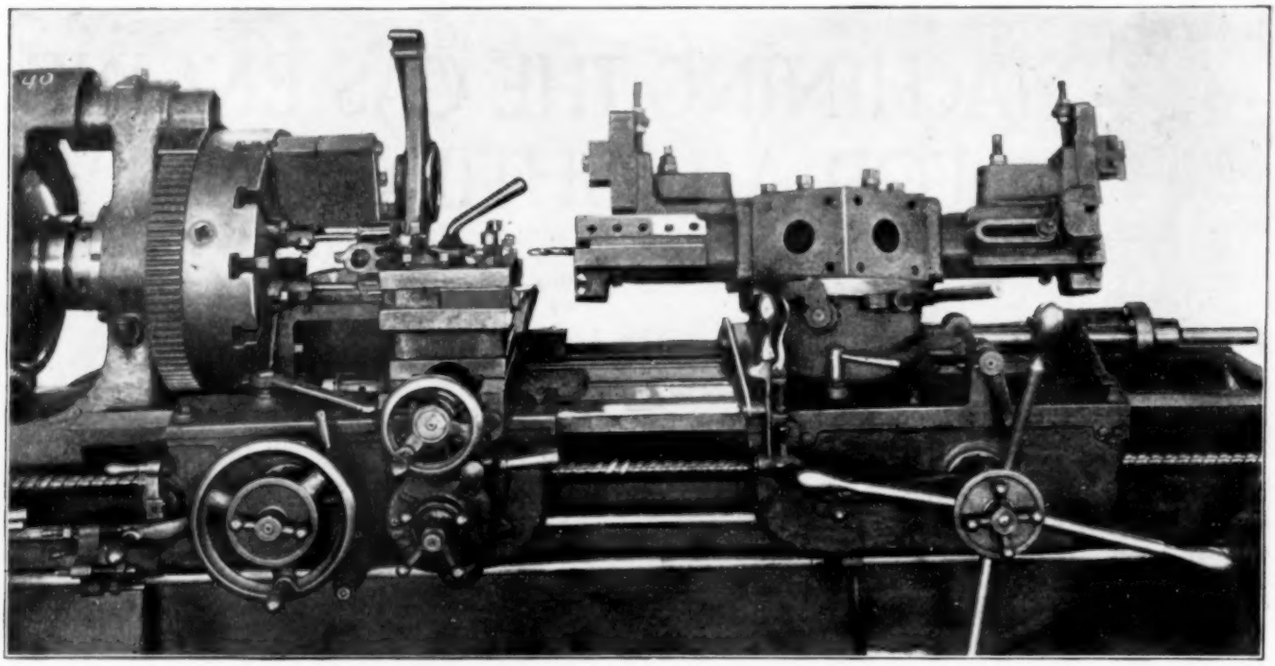


FIG. 10. TOOL SET-UP FOR FINISHING CYLINDER HEADS IN TURRET LATHE

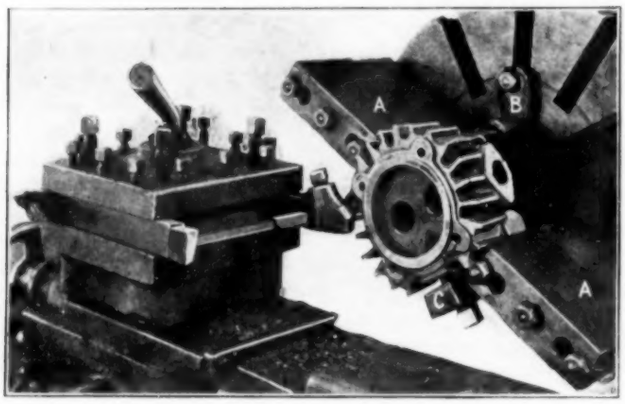


FIG. 11. HIGH JAWS REQUIRED FOR HOLDING CYLINDER HEADS

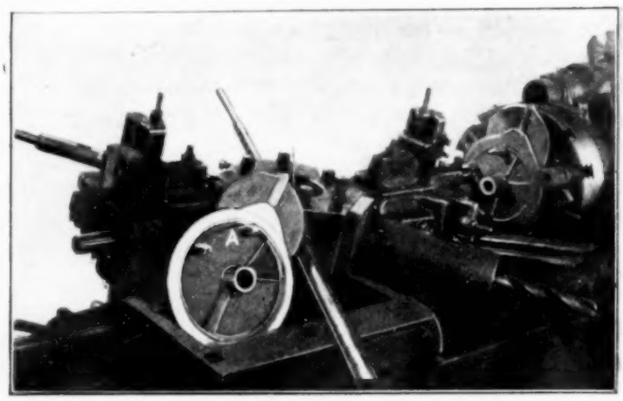


FIG. 12. LATHE MACHINING CRANKCASE COVER

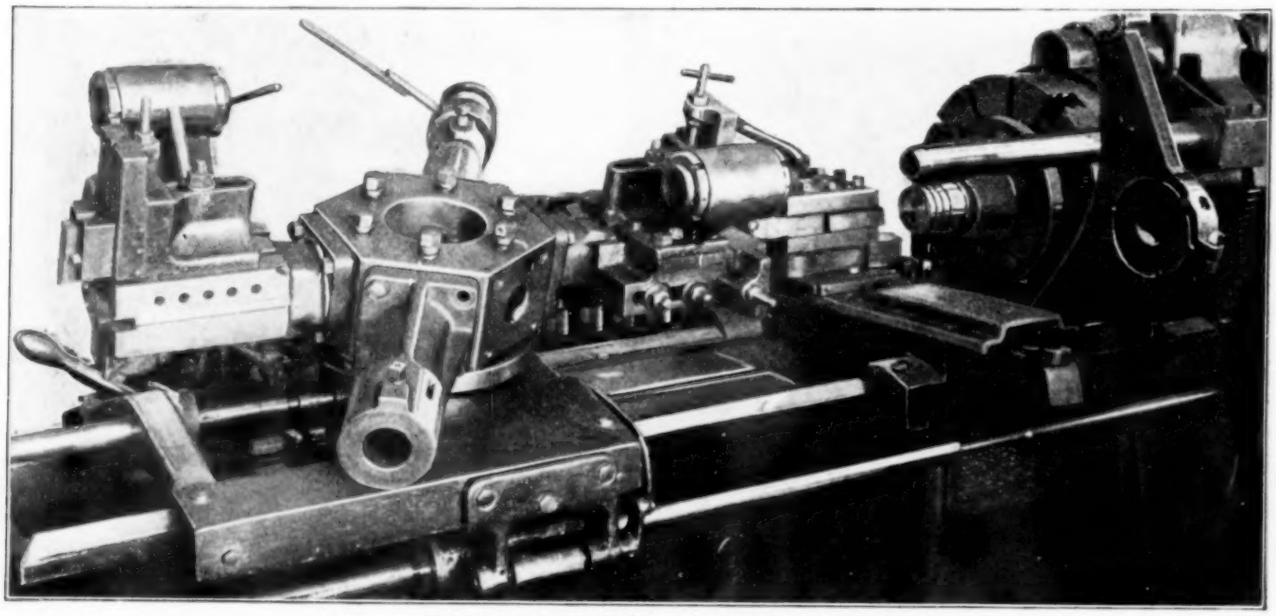


FIG. 13. SECOND LATHE OPERATION SERIES ON PISTONS

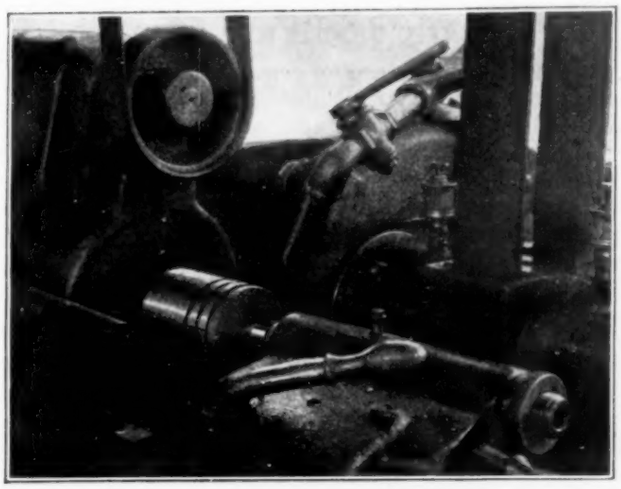


FIG. 14. GRINDING PISTONS

a profile tool, carried in the toolpost, cuts the three piston-ring grooves, Fig. 13. As mentioned in a previous article the cylinders are accurately reamed to size and not internally ground, but the pistons are finish-

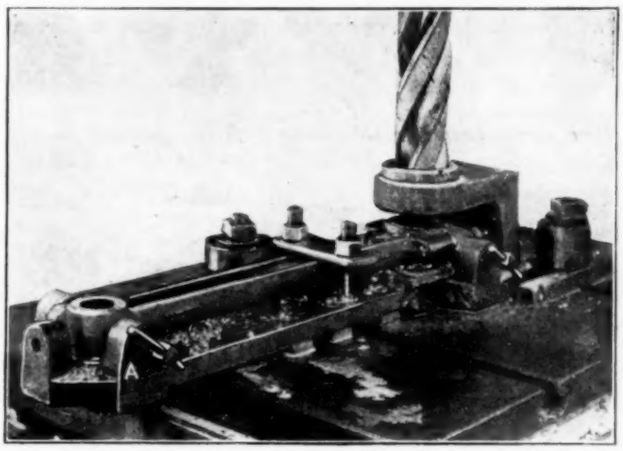


FIG. 17. DRILLING BEARINGS OF CONNECTING-RODS

ground outside to accurate diameters. The grinding operation on these pistons is shown in Fig. 14. A sal-soda mixture coolant is used.

The fuel injector or aspirator is a small elbow cast-

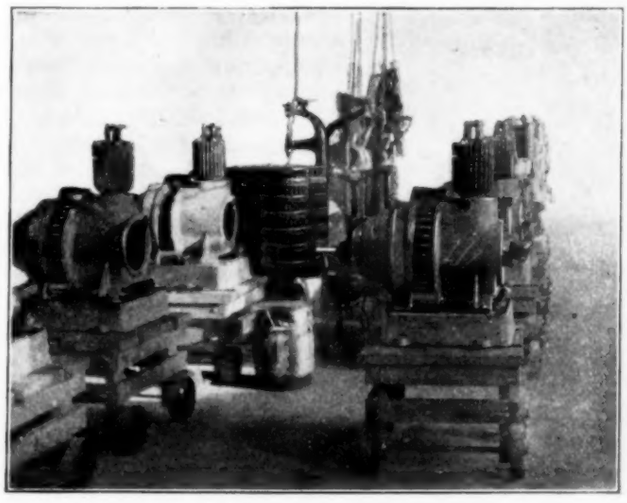


FIG. 18. ASSEMBLY FLOOR FOR LIGHTING UNITS

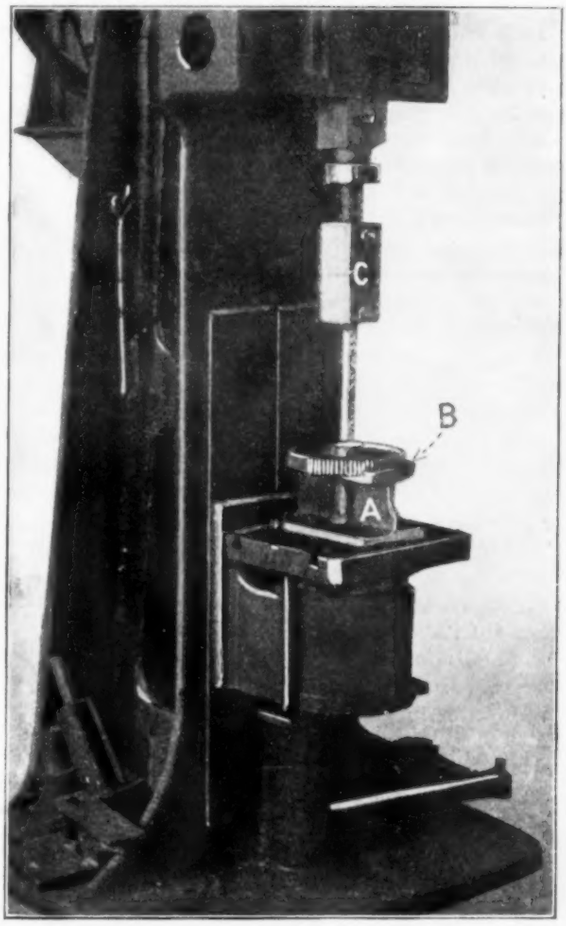


FIG. 16. DRIVING THE SHAFT INTO THE LARGE TIMING GEAR

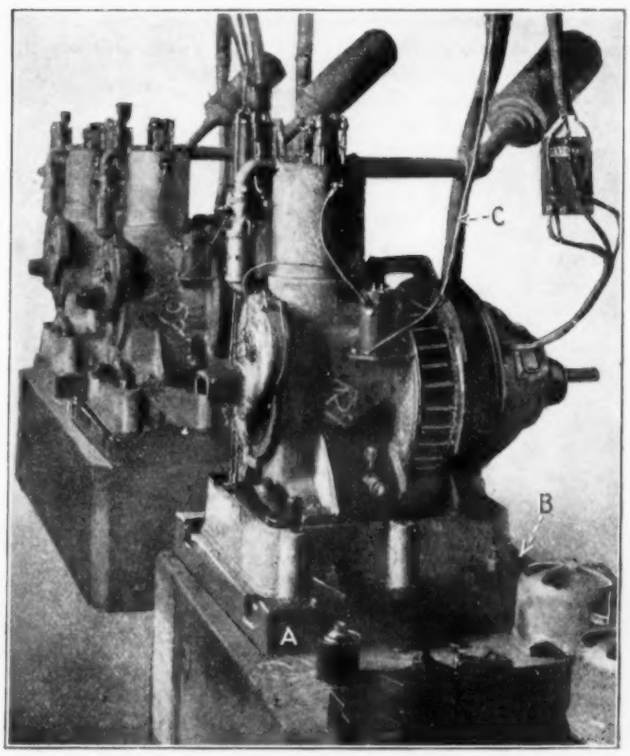


FIG. 19. LIGHTING UNITS ON TEST BURNING KEROSENE FOR FUEL

ing, both ends of which are bored, reamed and faced on a Gisholt turret lathe, Fig. 15. A special holding fixture bracket *A* is provided for this part, and the lathe as seen here is operating on the outside end of the casting. A finished casting may be seen lying at *B*. A similar bracket is used for supporting the casting during the operations on the other end.

A vertical power forcing press, Fig. 16, is used for forcing the shaft into the large timing gear. The gear is closely aligned by the fixture *A*, which holds the edge of the gear by means of the flange *B*.

The connecting-rods are held in the jig plate *A*, Fig. 17, during the drilling operations. High-speed three-lip drills are used for this work.

In starting the engine assembly in the plant of the Fuller & Johnson Manufacturing Co., the foundation castings are first placed on individual small-wheeled trucks, Fig. 18, and remain on these through all operations of assembly until the completed unit is taken to the testing floor. On these trucks the engine may be passed along to different portions of the assembly floor in progressive stages and all heavy lifting and crane work is thus avoided.

The foundation used for the engines on test consists of the cast-iron plate *A*, Fig. 19, to which they are securely bolted. This plate is mounted on a concrete base. To assist in sliding the engine unit from the assembly truck to this testing base, the latter is equipped with a roller. In this testing-room view, the two rear engines are running carrying full load, without vibration, and, notwithstanding their kerosene fuel, are exhausting through the mufflers which may be seen extending diagonally above them directly into the testing room, without any perceptible smoke or odor. After the carburetor has been properly adjusted for the engine, these exhaust pipes are connected to the flexible exhaust pipe *C* extending down from an overhead exhaust system so that the burned gases will be conveyed away from the testing floor. These engines use no hot air other than a small quantity which is drawn by a breather pipe from the crank case in order to keep the latter free from oil fumes.

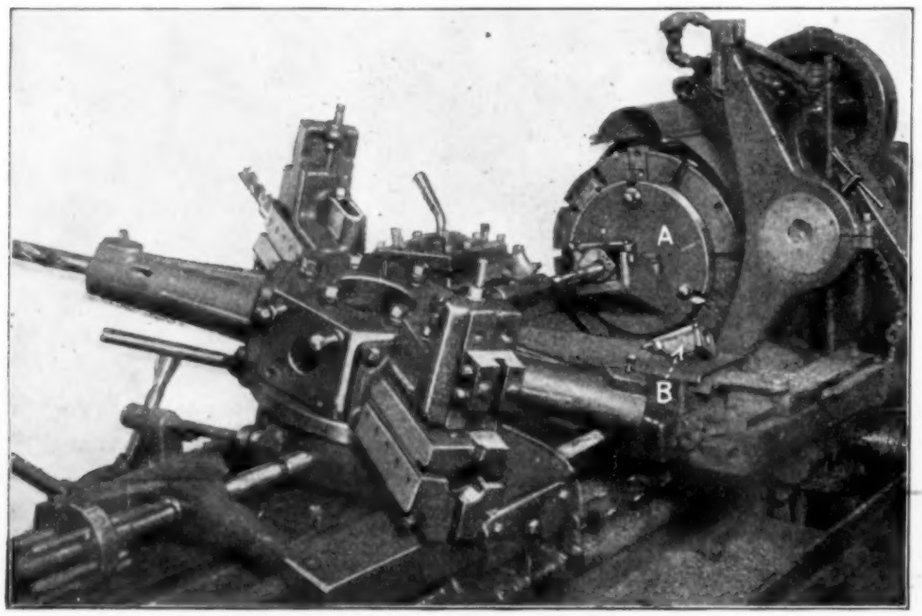


FIG. 15. MACHINING FUEL AND AIR FEEDER CONNECTION

Electric Steel Production

That the manufacture of electric steel is now a well-established industry is shown by statistics recently published by the American Iron and Steel Institute.

While the total annual steel output of the country has about doubled in the last five years, the tonnage of electric steel has been increased twenty-fold. In tonnage the electric furnace leads the crucible by a wide margin, the latter having just about stood still since the electric furnace appeared. The electric process has passed the crucible and bessemer processes for the production of alloy steels and is almost equal to the open hearth acid process. A little more than 16 per cent of the 1918 alloy steel production came from the electric process; 36 per cent of the 1918 electric steel output went into alloy steels.

The total tonnage capacity of the electric steel furnaces in 1919, of the United States, was about 1,350 short tons. On the basis of three heats per day, operating 300 days per annum, these furnaces are capable of producing 1,215,000 short tons. This is the possible production on an 8-hr. day basis, provided there are no interruptions. For continuous operation of 24 hrs. per day it would be possible to average five heats per day on casting and ingots, taking into account delays for repairs.

On this basis the annual capacity would be 2,025,000 short tons.

The increase from 155 electric steel furnaces in the United States in 1917 to 330 in 1919 is about 113 per cent, and the increase from 1910, a period of nine years, is about 2,500 per cent.

Among the chief reasons for this phenomenal growth in the electric steel industry should be mentioned the following:

1. The electric furnace met the demand for a more scientific way of producing uniform steel.

2. The results obtained in general average practice indicated that the electric furnace steel was uniformly better by a startling percentage.

3. Due to the fact that electric steel can be poured at a much higher temperature in a still or dead condition, it has become possible to produce intricate thin section castings with regularity and without high percentage of rejections.

4. Quality of electric furnace steel offered a possibility of applying a distinctly new atmosphere to the sales work. This was directly in line with the demand for quality products of all kinds which has grown up in the past few years.

The demands of the Government on account of war-time requirements and the development of new fighting machinery brought out requirements which could only be met by using the electric furnace.

This naturally stimulated the industry and placed it on a firm foundation.

A Foundry That Perseverance Built

By FRED H. COLVIN
Editor, *American Machinist*

JUST on the outskirts of the City of Pensacola, Fla., is a small foundry which has many unusual features, not in the way of special equipment, but as an example of how perserverance and the determination to make good, has made it possible to build a substantial foundry business from the smallest kind of beginning. Starting with one man as a helper, Joseph A. Stauter began building the business of the Bay Shore Foundry Co. about five years ago with almost no capital. His main asset was a thoroughly practical knowledge of both pattern-making and foundry work, a combination which has proved particularly successful in a foundry of this size and kind. The whole equipment is homemade, the cupolas being built of discarded steam boiler shells, and the charging platform and runway being primitive as shown in the headpiece. The cupolas can together handle enough metal for a 4,000-lb. casting, and some of the emergency ship work done during the past two years has taxed this capacity to the utmost.

In these days of huge manufacturing plants, many of which have never gone through the primary or small shop stage, it is of peculiar interest to find a comparatively new plant which has been built, almost from nothing, from the ground up. It is still small, but so are the opportunities as compared with large industrial centers; but it shows that skill, plus perseverance, can win out under adverse circumstances.

A general idea of the layout can be had from Fig. 1 which gives approximate proportions, the office being the latest addition and being clearly shown at the extreme right of the headpiece. Near this is the "skull cracker" or casting breaker shown in more detail in Fig. 2. The weight or drop is hauled up by means of the windlass shown in Fig. 2, the windlass being operated by manpower. The brass furnace is shown in Fig. 3, which also shows an old locomotive driving box to be broken and melted and a keg for drinking water at the extreme left. The core oven, shown from the outside in Fig. 4, is a comparatively new addition and has a counterbalanced door of plate iron to retain the heat and also reduce the fire hazard in the shop. The top is of sheet iron, covered with a layer of sand about 6 in. deep which makes a very good nonconductor. The heat is secured by building a wood fire inside the oven itself.

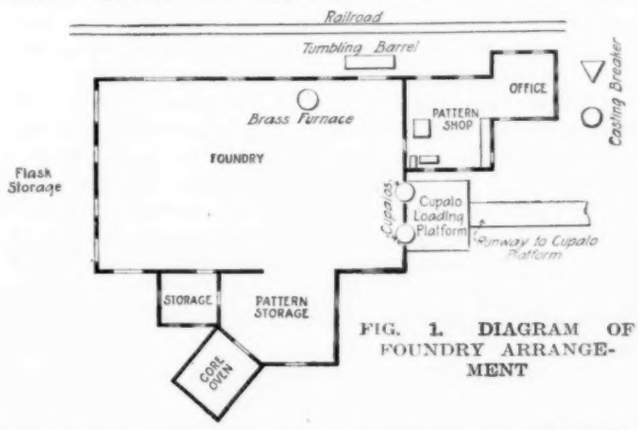


FIG. 1. DIAGRAM OF FOUNDRY ARRANGEMENT

Fig. 4 also shows a large pouring ladle and a good sized flask used for making one of the large castings for the emergency ship work previously referred to. Part of the flask storage is shown in Fig. 5, the flasks under the shed being cast iron with well-fitting pins. The tumbling barrel shown in Fig. 6 is just outside the foundry door and is substantially mounted on concrete blocks as shown. This is a very modern tumbling barrel and is particularly interesting, because both the patterns and the castings were made in this foundry. Before criticising the out-of-door appearance of much of this foundry, it must be remembered that the climate in and around Pensacola very seldom gets much below freezing and is far above this temperature much of the time. A closer view of the runway and charging platform is seen in Fig. 7.

FIG. 2. THE SKULL CRACKER

The accompanying cuts should prove interesting to those familiar with foundry methods in the North, because they give an idea of the effect of conditions and locality upon founding processes. The group of frame buildings would not

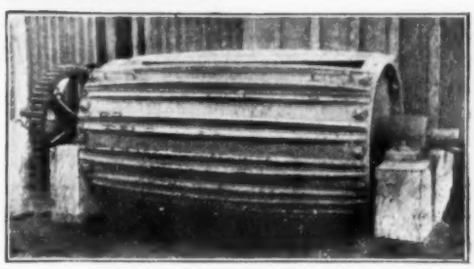
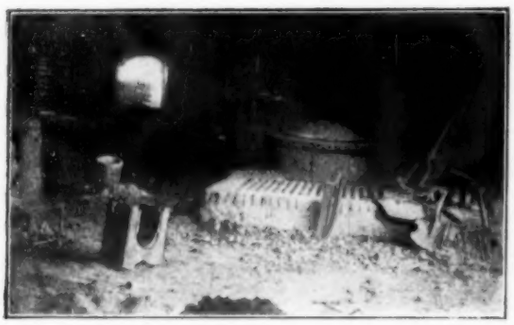
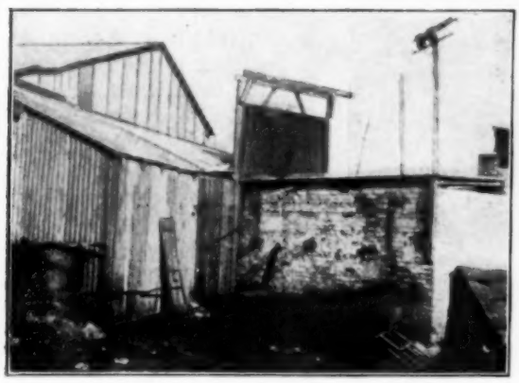


FIG. 6. THE HOME-MADE TUMBLING BARREL





FIGS. 3, 4, 5 AND 7. VIEWS OF THE FOUNDRY
Fig. 3—The brass furnace. Fig. 4—The outside of the core oven and large ladle. Fig. 5—Part of the flask storage. Fig. 7—A closer view of the runway and charging floor.

compare favorably with the big modern foundries, with their large-scale production methods; but that is not the point of this story, as has been explained.

At the present time there are two members in the firm, B. M. Bell having joined the concern to look after the business end, which now requires that a responsible man be in the office at all times during the day. This allows Mr. Stauter to spend his time in the plant, and may be taken as an evidence of the growth of the business and its present activity.

Scientific Argument, or Jazz Publicity?

PROF. C. W. PARK
University of Cincinnati

About a year ago, a good many people, as the phrase went, were "jumping up and down with idealism." They awoke each morning expecting to find a new heaven and a new earth, or rather a new earth that would be so perfect that heaven could be dispensed with as no longer necessary. They expected to see not merely the millennium, but their *interpretation* of the millennium, ushered in immediately and completely. It was all very simple. Just a signature here, a decree there, and presto!

Among the reforms that were to bring about this golden age was the adoption of the metric system by the United States and England, as advocated chiefly by the World Trade Club, of San Francisco. Their propaganda in the name of James Watt and all things anti-Hun will be remembered by all who received copies of a circular designed to convert the reader instantly, and enclosing for his convenience two stamped envelopes for addressing an appeal to President Wilson and David Lloyd George, respectively. How many kilograms of paper or liters of ink were expended in this campaign, would be difficult for outsiders to estimate.

The merits of this scheme from the standpoint of practical affairs have been discussed elsewhere in these columns by men who know what its effect would be. Quite apart from the subject matter of the famous Watt circular is its method, which is surely unique in the annals of scientific literature. Its circus-poster style and its spirit of palpitating pep are illustrated by the following quotations, which the reader is challenged to examine in an attitude of dispassionate scientific inquiry:

"Yes, the time has come when both of these nations (Britannia and America) must align themselves with the rest of the civilized world. They are too progressive, too patriotic, too democratic, too scientific, too forward-looking to hold aloof from civilization and to perpetrate methods so wasteful, and so inadequate, so hazardous to the life of the nation."

"President F. O. Wells of the Greenfield (Mass., U. S. America) art cap die gage hole jig jag nib nub rim ream slot slip slit slide snip screw tab tip top test terse tie tread trim tug tube zig zag machine-tool Co., the concern that manufactured so many things indispensable to the supply of war munitions, declared (and hosts of other experts agree with him) that the German kaiser would not have dared declare war if America and Britannia had been standardized on metrics when the Germans adopted the system exclusively in 1871. In that event they could instantly have co-operated with one another and with all their allies, co-ordinating the supplies and munitions from every part of the world."

"After the World War, whatever else may be, the world will be a smaller place. Whatever methods may add to better understanding and better business and better safety from German attack, this is surely the best of all. Why not try it? Foch has made 10,000 winning decisions for all allies, why not let Foch decide this? . . ."

"One weight, one measure, and one coin, will soon the warring world in friendship join!—and keep the World War won."

Much of the millennial fog of last year has cleared away and the noise of the panacea-monger is drowned by the hum of industry, for which, after all, there appears to be no satisfactory substitute. Judging from pending, or impending legislation, the metrical scientific enthusiasts, almost alone, persist in the original hope of a world made over by decree.

By Donald A. Hampson

The lure of the great outdoors, and the reports of easy money in the garage business have induced many a heretofore contented machinist to "chuck up" his job, borrow a little money, and set up for himself. There are many snares and pitfalls, however, and a few general hints for the guidance of the newly established machine-shop proprietor, or for those not hitherto connected with the automobile repair line who contemplate expansion in that direction, are here given by one who has been "through the mill."

THE passenger car business, which was held in check by the war for several years, has come back in a veritable storm during the past few months, with indications of keeping up at the present rate for an indefinite period. Besides the manufacture of new machines, there is a decided briskness in the repair and overhauling end of the business; cars that have been out of service for years, cars that were let go because of the scarcity of skilled mechanics, and the thousands of new cars being placed in the hands of new owners.

This volume of business should serve to fill the gap in scores of machine shops which find the old lines dull, and it should constitute a field for those that wish to expand or for the shop-of-their-dreams which so many ambitious men have longed to start.

Not All Easy Money

The "automobile game" is not all easy money; no more easy money than any other branch of the machine business. In fact it is the presence of those who make it a "game" that gives it a more or less deserved black eye, for it is an undeniable truth that retail selling has been characterized by sharp practices while the repair shop and service station department has often been manned by workmen of the "plumber who couldn't plumb," and the graduate stable boy, variety. One man, who in his heyday conducted a chain of garages and was wont to assert that "a machinist never makes a good automobile man," lived to see his house crumble about him; learning too late that customers ultimately find out a few things for themselves and avoid the unskillful workman.

If asked to state the first rule of success for any machine shop that wants to make a serious drive for the automobile trade, the writer would say this: "stay out of the garage end of the business." This may seem like poor advice to those who have heard that "you can make your rent on gas sales alone," and "storage is clear profit"; who have heard of the big money to be made out of the sale of old and new cars, or who have seen the Saturday afternoon string of patrons clamoring to have their work done. Go around on Tuesday morning if you would note the vanished gas buyers and the absence of work customers; wait for the long winter to eat up the profits of sales and storage—if then you are bound to do a garage business too, *do* so, but conduct it at a different location from your machine shop and with an entirely separate crew of men. Best of all, run a machine shop that *is* a machine shop and do the automobile work just as you do work on any other class of machinery. Every machine shop, large and small, should have its system of tool keeping, of discipline, of training apprentices or instructing new men or routing and dividing work, and of financial affairs.

The automobile is the most intensive piece of machinery in common use—then why is the machine shop not the logical, the very best, place to take it when in need of repairs? It is; and if it were not for the adjustment side of the business, the machine shop might easily cater to all the wants of the motoring public.

Road Work Not Good for Machine Shops

Adjustments necessitate road work and road work means running in and out of the shop, with several outsiders trailing along and the bench and machine hands looking up every time to see what is the latest excitement. Chauffeurs and owners and men-with-time-to-spare are particularly noisy when they come in from outside and they are extremely interested in the work they see being done in the machine shop. Spread three or four of these idle, inquisitive persons around in a shop of twenty workmen and you would have to charge $5 an hour to break even on the one job that drew them inside. It is all well enough to say, "Keep them out," but the chief mechanic calls the chauffeur in to ask something that was forgotten outside, or the foreman's buddy slips past the "No Admittance" sign with a wink, and soon the whole gang is back again.

Road work is a form of "service" and goes along with sales, adjustments, garage work, and garage mechanics; not machinists. Mixing this part of the business in with machine shop work in any plant small enough to want to take in repairs and jobbing is fatal to dicipline. That is a fact that will bear endless repetition. It is because it is so easy to be beguiled by persuasion and

plausible assumptions that this phase has been dwelt upon at length. Experience has so thoroughly demonstrated to the writer that a mixing of this sort only leads to financial distress and mechanical laxity, that he advises any machinist who feels that he must go into it to forget his trade and set up a gas-and-oil station in the nearest vacant shanty rather than invest one cent in machinery for one of these shops.

If automobile work is brought into the shop—parts to be refitted or made or repaired—go at them as if they were steam engine parts. Put a machinist on them who is equal to or may be coached in the job. Let the work take its turn, or use discretion as to how far a hurry job may rob other work under way. Supervise in the same way and insist on an equal standard of workmanship, even though the owner may not know iron from brass. When a man drives up and wants some one to do adjusting or tuning up, tell him frankly that you do not do that sort of work; tell him that you are leaving garage work to the garages and are concentrating on the very best kind of machine work you know how to turn out. In the end, this policy will make friends and bring plenty of business.

Do Not Trespass on the Garage Man's Field

A plan that has worked well for all concerned is for the machine shop owner to visit the garages in his town or community with a view of soliciting their business. Make an agreement with them to do all of their machine work—they to stay out of that branch and you to stay out of the garage and sales end. Such an arrangement is advantageous to the garages; it leaves them free to concentrate on service, it saves them the expense of tool equipment, and it raises the standard of their work, for the grade of repairing done by the man who has only picked up his knowledge of, say, lathe work and touches a lathe only two hours a week is very low indeed.

Machine shop work should bring a decided advance over garage charges, fully 25 per cent more and fifty would be a more equitable figure. In no other business is there the money tied up in tools and machinery that there is in shops; the workmen do not become skilled over night as do the "mechanics" of the garage, it costs money to train them and they in turn must spend years in training where application is essential. Compared with the building trades, whose investment is practically *nil*, machine shop work should bring twice their hourly rate. Good work is worth all it costs and is decidedly the cheapest in the end.

The writer was connected with a repair shop during the time that a dry town campaign was at its height, and one of the shop's best customers was a brewery that had a fleet of auto trucks and a plant full of machinery; our shop policy was "dry," on account of the saloon evil, and activity in the campaign automatically lost us the brewery's work, but in a year's time we had the brewery work back again simply because they knew that we did conscientious work and they found out that the other kind was expensive and risky.

Work that is brought in from garages is almost always done on a time basis. They accept without question the machine shop's charge and add perhaps 10 per cent for handling, thus relieving the shop man of a vast amount of kicking and disagreeableness. On the other hand, many customers bring their work directly to the shop for an estimate.

Experience has proved that there are two ways to make friends and customers of automobile owners, who usually are not mechanics. First: tell them frankly that they should buy factory parts explaining briefly the principle of quanity production and buying, with the certainty of getting thereby better parts for the same money or the same parts for less money; second, if an estimate must be made, make it high enough to begin with so there will be no extra charges when the bill is ready. The customer who has been advised to buy of the factory and decides not to has no come back; and there is generated a feeling of honest treatment to find that a job has cost a little less than estimated.

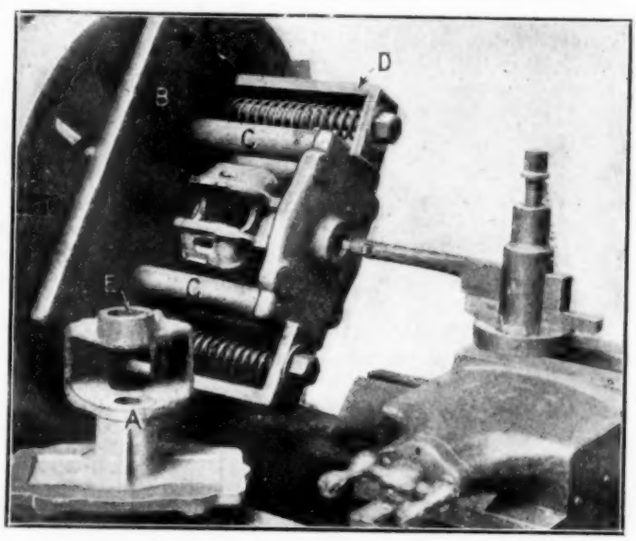
Education a Factor in Making Friends

Education is a big factor in making friends. The shop man who is familiar with materials and the latest processes and who is not afraid to explain these things as related to repair parts soon finds that he is drawing trade and making a reputation for himself as an informed man. In this latter connection there is nothing like the trade papers to keep one informed of what is new and what is being done elsewhere; the advertisements too are a help and they can often be used for the customer's benefit in cases where an address or article is wanted.

Lathe Fixture for Holding Irregular Castings

By John Vincent

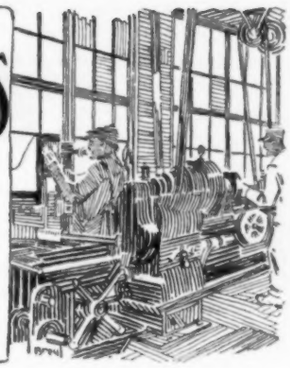
The steel casting shown at *A* in the illustration is bored in the tractor shops of the Minneapolis Threshing Machine Co. while held in the peculiar fixture shown bolted to the faceplate. Ordinarily a pot-chuck would be made for such a piece, but the device shown was made at much less expense and has proved serviceable. An old plate *B* is fitted with four heavy studs *C*, and also with a pin on the rear side which serves as a driving dog. The casting is held against the studs *C* by the spring-released clamps *D*, which relieve themselves from the work as soon as the clamping nuts are loosened. A pilot-stud, which fits the large previously bored hole *E* in the inside end, serves both to center the work and to prevent side-slipping.



LATHE FIXTURE FOR HOLDING BRACKET WHILE BORING

MODERN PRODUCTION METHODS

By
W. P. Basset
of
Miller, Franklin, Basset & Co.



IF WE compare the book-keeping and stock-keeping methods used in most plants, it appears that money is of great value until it has been transformed into material, whereupon what happens to it becomes of no moment. Executives must O.K. expenditures and sign checks, and the greatest of red tape is warranted if we make sure that no penny goes out of the business without a good reason, and that a proper charge for it is made against something-or-other.

But when the money comes back into the stockroom as material we lose all respect for it. The receiving clerk will "guess" that it is all there. Many of us don't even look it up; just let any workman who "needs" it help himself. Or if we do demand that he have authority for using it, we are seldom persnickety about what it is to be used for. If, at the end of a month or so, an actual count shows that we have only 95 per cent of the material on hand which our stock records show we have, we correct our records to agree with the count without investigating. Suppose we handled our bank balance that way?

III. Need for Systematic Stock Keeping

Just why a man or corporation will take scrupulous care of every cent and then leave stock worth hundreds of dollars in places where it can be stolen with the utmost ease, is more or less of a conundrum. In this installment the author presents some specific remedies for this evil.

(Part II appeared in our April 22 issue.)

Of course, accounting for stock can be so surrounded by red tape that loss results. Good sense and a knowledge of the needs of each shop must dictate to what extent we go. But we must not forget that the stockroom is a tool of both production and cost finding and can be made a most valuable one to both. With this in mind, let us see why we have a stockroom in a machine shop. It is by means of the stockroom and the stock-keeping records that we are able:

1. To make sure that all material is used for the purposes of the business.
2. To prevent production delays through lack of needed material.
3. To prevent over-buying with the consequent "freezing" of working capital.
4. To make sure that all material will ultimately be accounted for as part of the cost of the finished product.
5. To facilitate taking the inventory.
6. To save the time of men, who, when they need something, can count on finding it in a certain place, instead of roaming around the plant searching for it.

Many of the points I am going to make in this discussion of stock keeping may seem too obvious, but my experience shows me that it is often the most obvious things which are overlooked in managing a shop.

An instance of what I mean came to my attention when the owner of a shop complained to me that much of his finished stock, consisting of small brass parts, just the right size for a coat pocket, disappeared unaccountably. He apparently saw no connection between this shrinkage of finished stock and the location of his finished stockroom. This stockroom was open both to the factory and to the outer world—it was the exit through which the workers left at night—and the stock clerk himself almost invariably "beat the whistle." When so obvious an invitation to theft is not obvious to the man most concerned I feel that I cannot go wrong by at least mentioning the "obvious."

The location and design of the stockroom and the routine of running it are all dictated by the six aims set forth above. Of course, physical conditions will sometimes be such that the ideal cannot be realized—so the best possible compromise must be accepted. The materials carried in stock by a machine shop may be of five kinds: 1, raw materials; 2, partly finished materials; 3, finished materials awaiting assembly; 4, finished materials awaiting shipment; and 5, supplies or so-called non-productive stores. In some shops only raw materials and supplies will be kept, the product going straight through the plant and being shipped as quickly as finished. In others al lor part of these stocks will have to be carried.

Whether all of these classes of stock shall be kept in a single stockroom, whether two or three shall be grouped, or whether each class shall have a room of its own depends upon the size of the plant, its arrangement and the total amount of stock kept. In some plants it is easy for one man to care for and issue all classes of stock; therefore if space is available all of the stock may be kept in a single room. Of course bulky material of comparatively low value per pound like pig iron, heavy plates, castings and so on may safely be kept in an open space like a yard, close to where it will be used. This saves valuable floor space and heavy trucking, and there is little chance of material of that sort disappearing.

If the stock carried is so large, or if the issues and

receipts are so frequent, that the full time of several men is required it is often best to split up the stockrooms so that each may be put in the best possible location. In many machine shops that cover considerable area, this has been done. One of these shops manufactures large quantities of several assemblies to order. It is a quantity production proposition and many of the parts are common to several assemblies so that a considerable quantity of finished parts is carried in stock.

This shop combines in one stockroom its raw materials (which consist of small castings, gear blanks and bar steel) and its supplies of non-productive stores. This stockroom is located as nearly as possible in the center of the plant. The factory was originally so designed that freight would come in handy to this stockroom. By this arrangement the trucking of raw materials and supplies both to and from the stockroom is at a minimum.

The finished parts are kept in a separate stockroom adjoining the assembly floor, so that no long hauls are needed when they are ordered out.

This is usually the ideal way to locate the stockrooms, but it cannot always be achieved. The rule, if we were to make one, would be, "Store everything close to the department which will use it so that trucking and time may be saved."

When, for instance, a plant is spread out over an unusually large area the first operations on various products are apt to start at widely separated points. This may make it desirable to split up the raw material and supply stock, locating them near the primary departments.

Location of Stockroom a Difficult Problem

In buildings of several stories the location of stockrooms often presents difficult problems. Receiving and shipping must generally be done from the ground floor, while the process quite often starts at the top of the building and the material flows downward. Usually under these conditions it is best to store the stock on the first floor. It must be taken to the top sooner or later; usually the light is better on the upper floor and is more needed for manufacturing departments than for storage; and if the stock is heavy it would often be quite expensive to build strong enough to allow it to be carried on an upper floor.

I consider that poorly arranged stockrooms are one of the most potent causes of leaks and delays in production. In one plant I recall, a mere physical rearrangement of stock not only eliminated most of the delays in production, but by giving the management a correct knowledge of what they had in stock and where it was, cut the amount of the inventory 31 per cent. The stockroom as it formerly existed is shown in Fig. 6.

The cases, barrels and kegs extended back about 80 ft. A barrel of brass trimmings can be seen perched atop a keg of rivets. The particular style of trimmings contained in the one barrel was almost a year's supply.

It was a recent arrival purchased at the then high price of brass; yet piled behind the many cases in two different places were two more barrels of the same trim purchased at a lower price.

Their existence was not suspected until an investigation brought them to light, for when an impatient shop superintendent failed readily to find the trim he sought, a further supply was ordered. The style of assembled product changed before all the trim was used and the excess became obsolete and was scrapped.

It was easy to arrange this stock so that the location of each item and the amount on hand could be known.

Of course this looks like an extreme case. Because of the apparent disorder it may be. But not infrequently the well-kept, orderly looking stockroom is actually, though not apparently, just as bad. If no one knows where the materials are that are so neatly piled, they might just about as well be piled helter-skelter. Take, for instance, the wastes that were eliminated in one well-equipped stockroom which at first glance seemed to be admirable.

The finished stock department of this plant employed thirty-two men, exclusive of seven clerks in the office. This force was divided into four general groups: receiving and storing, inventory, mail order parts and delivering parts for assemblies. As the department had grown from a comparatively small beginning to its present size, additional metal bins and shelves were provided, but no particular attention had been paid to providing a fixed location for every part. The old method of receiving a truck-load of parts was to find an empty bin, dump the parts into it and then rely upon the memory of "Jack" or "Gus" when the part was needed.

FIG. 6. A BADLY ARRANGED STOCKROOM

No attention was paid to grouping like parts or arranging the parts most frequently used in a convenient manner for discharging. For example, in making up one assembly the requisition might call for nuts of several different sizes located in a number of sections, 20 to 40 ft. apart, which necessitated considerable back tracking and lost time. The following steps were taken to improve conditions.

First, we made a new layout for the entire department with a definite and fixed location for each part, grouping like parts in one section or locality, to give the minimum amount of travel in making up the order.

Incidentally, in this stockroom we effected a considerable saving of wages by means of a wage incentive plan. All parts were classified; the large parts went into a class by themselves; the small parts into ten classes covering them all. The class each part went into was determined by the size and time required in handling the part. Time studies were made from which to determine the number of pieces of each class which could be handled in an hour.

For putting away, counting, making up assemblies and so on, for a certain fixed number of pieces of any

class, the man or gang is given one unit, the units of the entire force are totalled up each day and divided equally among the gang at the end of the day period, each man receiving a bonus according to the number of units earned. By this method a man can be transferred from any branch of the stock department activi-

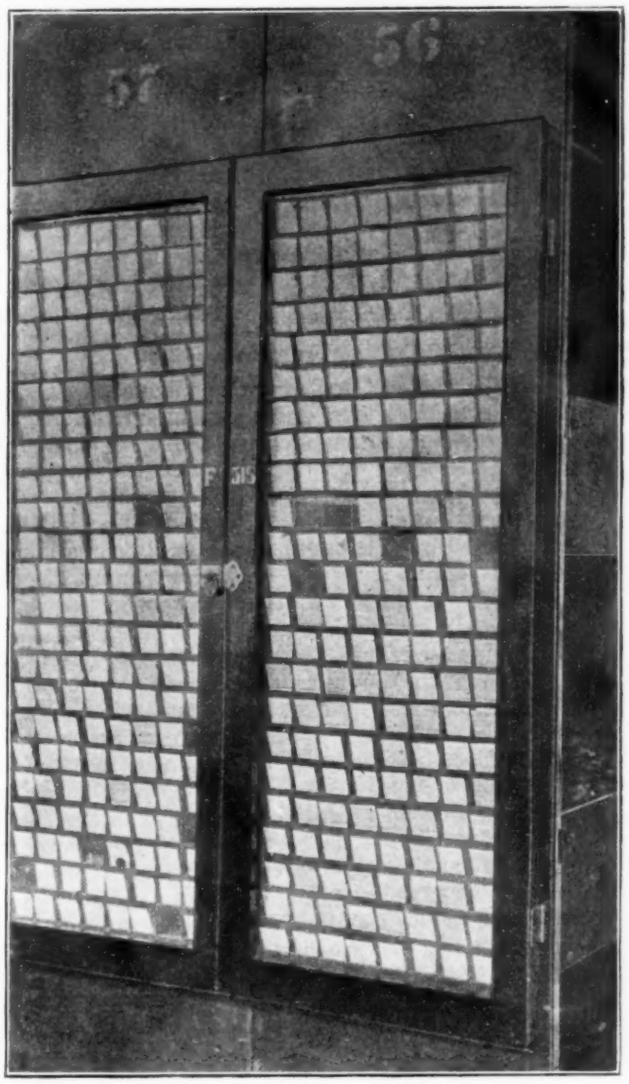


FIG. 7. INDEX BOARD FOR STOCK

ties to another without affecting his bonus or necessitating the services of an extra time clerk. These improvements resulted in reducing the stock department force approximately fifty-five per cent.

This incident brings out one point quite pertinent to the present discussion; that of arranging the parts. There are three ways that parts may be grouped. The most common is to follow no particular plan—simply to utilize the nearest vacant space.

The first attempt at order usually is to arrange the parts by part number, or by type of part. As part numbers frequently are assigned in order as the part is designed, this method has little to recommend it except that it does offer a chance to index the stock. In some shops it may be best to group parts of a kind, having, say, all bolts, or all valves, in definite sections. But for concerns turning out an assembled product in quantities, it is usually best to group, so far as it is feasible, those parts which go into similar assemblies. Often the parts for several assemblies differing only as to a part or two can be grouped in a single section so that the stock keeper can pick out the parts needed for an assembly without chasing all over the room and perhaps holding up production while he chases.

If the assemblies have been properly engineered it is easy as a rule to make the stockroom self-indexing by part numbers. The parts for similar assemblies will have similar numbers so that if the bins and shelves are laid out by assembly letter and part number they will be grouped handily.

If the seasonal demand makes it necessary to carry widely varying quantities of a part this grouping may not be feasible, for it may be necessary at peak production to fill the usual bin and use several other bins —whichever ones happen to be empty—to take the overflow.

This method, in use in a well-run machine shop, handles this condition well. The stock—small parts and large—is kept in bins and on shelves, to the front of which are attached bin cards showing the part number, the name of the article, the location of the bin, and the record of receipts and withdrawals. This bin card really is not needed—a number to identify the bin would be sufficient.

The unusual part of the system lies in the index board by which the stock clerk can tell at a glance where he will find any needed parts. This is shown in Fig. 7.

The Stock Board

The stock board contains small pockets, each being given the number of a part in rotation. Whenever a supply of a given part is put into a bin a small ticket is made out and put in the pocket bearing the corresponding part number. This ticket shows the exact location of the bin in which the part may be found.

If several bins contain the same material, a separate tag is made for each bin and kept in the single pocket. Thus when the stock clerk wishes a part he goes to the board and under that part number sees at a glance just which bins contain the parts wanted and how many parts are in each bin. Vacant pockets of course show empty bins which are available.

You may note that a ticket in the third row of pockets from the bottom, on the left of the board, bears a dot. This is in reality a red tag, used to flag attention. It happened that the part in question was stored in several partly filled bins and it was desired to empty one of them as soon as possible. The next order for that part will be taken from the "flagged" bin.

Stockroom Equipment

Whether to build the storage equipment of wood or steel and what the parts shall be stored in are important questions. While steel is usually more expensive at first than wood, the economies in operation are continuous. Wood wears out rapidly, is less adaptable to expanding needs than steel, becomes dirty and oil-soaked and is a considerable fire risk. Then, too, with steel the stock can be concentrated in much less space than with wood.

Whether materials can best be stored on racks, on shelves, in bins or in tote boxes is often settled by the nature of the material. Personally, I believe that tote

boxes are not used for storage as much as they might well be. They offer great possibilities for economical storage, provided thought is given to their use.

Often they are too large to be a really desirable unit and storage space is wasted because a partly filled box takes up as much room in the stockroom as a full one. In one plant, where the stockroom was in chaos, due largely to congestion, a study showed the following condition in one section alone:

No. of Boxes	Condition	Boxes Actually Needed
134	boxes completely filled	134
46	boxes one-quarter full	12
68	boxes one-half full	34
70	boxes three-quarters full	54
318	boxes used	234 needed

Obviously by using smaller tote boxes and filling them to capacity the same amount of material could be kept in 73 per cent of the space.

The boxes in use were of wood. Their outside measurements, 18¾ x 40½ x 34¼ in.; the inside measurements, 17¼ x 36 x 33½ in. In other words nearly 20 per cent of the space occupied by tote boxes was taken up in storing the lumber of which they were made rather than the parts with which they were filled.

We therefore reduced the size of the boxes and had them built of sheet steel instead of wood with the result that now on the same racks we can store 72 per cent more material. Incidental advantages from the change are that the fire risk is less, the smaller tote boxes are more easily handled in the shop, and the metal boxes can be nested so that they take up less room when empty.

I do not say that metal boxes are always best. I know one shop, in which the parts made are mostly very small screw-machine products, where collapsible cardboard tote boxes are used to advantage. They are made in a variety of sizes so that lots of widely different quantities can be stored in boxes of just the right size. When empty the boxes are folded to take up little space. Of course they wear out rapidly, but offer a low first cost as compared to steel.

As a rule, though, it works out better for most shops to standardize one or two sizes of metal tote box, small enough to be handled easily.

Where parts are made to stock which moves rapidly, shelves can be constructed in the storeroom to fit the boxes. Parts can then be stored without removal from the trays in which they have been carried while in process and can be reissued for final assembly in the same boxes. This avoids a large amount of rehandling and reduces the work of taking inventory.

The trays are relatively inexpensive, and are almost indestructible, so that the investment is usually not very heavy.

The excessive cost of handling small parts in boxes of various size and shape is often not appreciated. In one plant we found that the time consumed by the operators in moving pieces from one box or bin to another amounted to 15 or 20 per cent of the total time required for the productive operations. The standardization of the boxes and the method of handling resulted in a large net return on the investment.

So much for the physical side of the stockroom.

Importance of Accurate Stock Records

The stock records are the key to all factory routine, whether costs or production, and they should therefore be kept by someone capable of keeping them accurately. As a rule the type of man most suited to handling the stock itself is not the best clerk, so that leads us in most shops to put the stock records themselves in the office.

Where the factory production is planned, the planning department is the one most interested in the stock records and so should keep them. I shall first describe the routine found most successful in plants having a planning department.

In general the stock records to be used are of two kinds, dictated by whether the shop turns out a standard product which the sales department must dispose of, or whether the sales department sells an order which the shop must make up.

In the first instance the raw material purchased will be based on the sales department's estimate of future sales; in the second the materials are ordered in quantities sufficient to fill an order actually sold. The first condition allows as a rule much the simpler stock forms.

For one thing, no records need be kept in the stockroom itself, except some device whereby the storekeeper may tell quickly the exact physical location of all materials. The perpetual inventory sheet or card will be kept in the planning department, for it is safe to assume that a concern of this sort which is so well adapted to production planning will not try to do without such planning.

Cards are much used, but personally I prefer loose sheets kept in a stock book, for cards are easily put into pockets or stuck up behind telephones where they often stay. Fig. 8 shows a good stock sheet, while for the card "fan" Fig. 10 is good. If the demand is sufficiently seasonal to make it desirable to have the

MAK _____ ARTICLE _____

MIN. _____ UNIT _____ SIZE _____ LOCATION _____

[redacted] FORM 333 500-9-18

ORDERED			RECEIVED			APPORTIONED			USED			BAL. AVAILABLE	
DATE	ORD. NO	QUTY.	DATE	PRICE	QUTY.	DATE	ORDER NO.	QUTY.	DATE	ORDER NO.	QUTY.	DATE	QUTY.

FIG. 8. STOCK SHEET

maximum and minimum quantities change from month to month, this can be provided for as shown in Fig. 9.

The "minimum" method of controlling the supply of material is fairly well understood and applied throughout manufacture, but frequently the minimum is based

FIG. 9

Article BLADES

Description

Mark or Size 3/4 x 5/16

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Min. Max.	450	450	100										Min. Max.
	150	100	50										

Section Bin or Shelf

Ordered		Received		Delivered			
Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity

Article

Description Size

Maximum

Minimum

Section Bin or Shelf

Ordered		Delivered						Balance	
Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity

FIG. 10

FIG. 9. STOCK RECORD WITH PROVISION OF VARYING MINIMA. FIG. 10. ANOTHER FORM OF STOCK RECORD

upon an "educated guess" and not in accordance with conditions actually governing manufacture.

A "minimum," theoretically, is a quantity which should bear a definite relation to the sales or probable production, and it is therefore necessary to determine the demand for finished product and to reduce that demand to its equivalent in terms of material. Take as an illustration a manufacturer producing a line of assembled articles composed of about fifty parts, each carried on a minimum basis.

To determine the minimum we would proceed somewhat as follows:

A "part" card is used and this card shows every finished article on which the part is used and also the quantity used for a dozen of each finished article. The estimated sales are then entered on the card and the total of probable parts used developed therefrom. The minimum is then set as a certain percentage of this quantity, expressed in terms of so many days supply, as 30, 45 or 60 days, dependent on the length of time needed to make the replacing order quantity.

The requirements of raw material are ascertained by means of a "material estimate card." This card shows every part which uses the same kind and size of material shown, and the quantity of material required per hundred. The number of parts shown on the cards is then employed to determine the probable total material requirements, which amount is then used to determine the minimum stock of material to be carried.

The minimum must be of a size sufficient to allow the production, shipment and receipt of the replacing order quantity and it, too, is expressed in terms of so many days supply, as 30, 45, 60 or 90 days.

This describes briefly a very simple yet accurate means of setting minimum quantities and is peculiarly suitable to assembly manufacture.

To get back to the records. Note that in Fig. 8 there is a column headed "Apportioned" which does not appear in Fig. 10. Sometimes it is desired to set aside a part of the available stock for an order which it is known will be run but which is not needed at once. If all orders are run as soon as the requisition for the material is issued, this is not necessary.

As a purchase order is placed and as material is ordered out of the stockroom by requisition the transaction is recorded on the stock record for that material. When the clerk having charge of this record enters a requisition which brings the supply of the material close to or below the minimum quantity he enters the item on a shortage report like that shown in Fig. 11.

This is the purchasing agent's authority to buy more of the material. He has no authority to order until automatically instructed to by the stock reaching a minimum.

It is good practice to send this shortage report to the stockroom so that the stock keeper may actually count the stock of that item as a check against the record. This enables him to keep a frequent check easily for he makes his physical check only when the stock is smallest and thus can be counted quickly. Furthermore the check is made at the most important time for if error is then discovered a needless order is prevented from going forth.

Some shops keep a double check to prevent the stock from falling much below the minimum by so arranging the stock physically that the stock keeper can see at a glance when the minimum is reached. If materials or supplies come in packages the minimum quantity packages may be marked with red crayon so that when a "red" box is opened the storekeeper knows he has gone below the limit. A cord may be tied around the minimum quantity of such materials as steel bars, so that the same effect is secured.

If the stock keeper fills a requisition which brings him below the minimum and he receives no shortage report he can jog up the clerk who keeps the records.

WEEKLY SHORTAGE REPORT

MAKE PHYSICAL COUNT OF ITEMS BEFORE ENTERING ON THIS REPORT

DATE March 15/18

DESCRIPTION	MAXIMUM TO BE CARRIED	MINIMUM TO BE CARRIED	LAST ORDER NUMBER	NOW ON HAND
SAFETY POSTS	1500	500	1472	496
BLADES	2500	1000	1340	1120

FIG. 11. SHORTAGE REPORT

This set of forms, and the routine we have described will, I believe, with minor changes to make them fit the individual shop, do for most machine shops. Certainly it will give definite control which is what a large number of concerns lack.

The problem of keeping stock records is somewhat different in the shop which manufactures large quantities of the same product to order. An example of

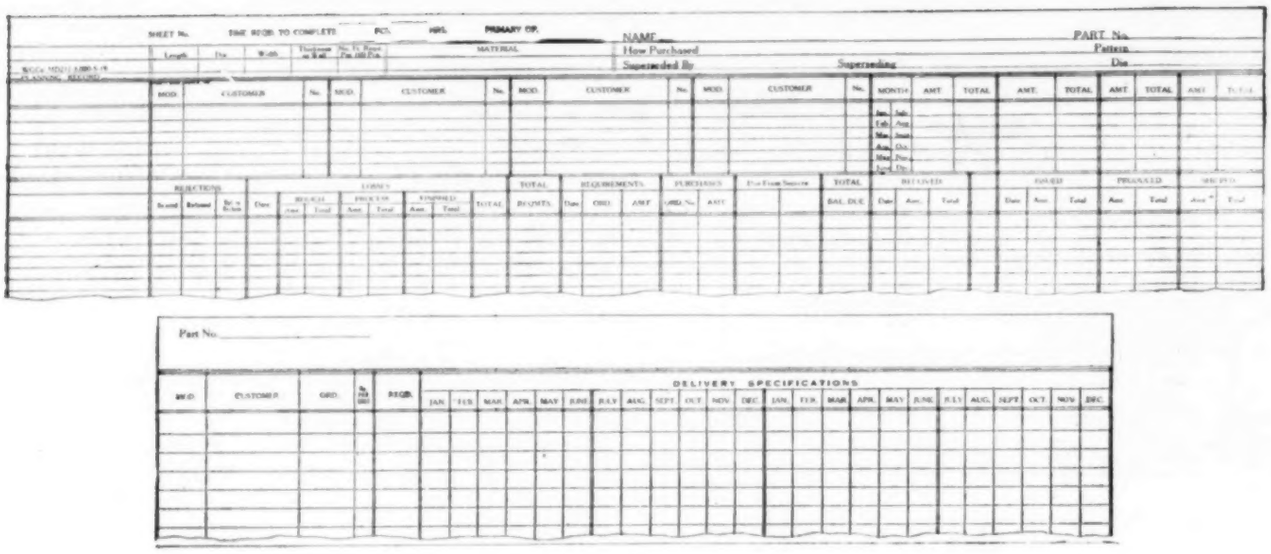


FIG. 12. PRODUCTION STOCK AND DEMAND RECORD

this type is the Warner Gear Co. which turns out automobile transmissions, differentials, clutches and so on in large quantities to individual specifications. This concern buys its raw material to cover sales orders and so carries practically no permanent stock of raw materials. Its stock is carried solely to cover sales contracts actually on hand.

The sales call for delivery of a certain number of assemblies monthly. Therefore, in buying the needed raw materials, the deliveries are asked for in such monthly installments as will permit of meeting the requirements of the sales order.

As the planning department is responsible for material from the time it arrives in the plant until the finished product is shipped, and as it must have absolute control of raw stock, it has been possible to devise a single form to give the needed bird's-eye view of material. It is shown in Fig. 12 and is called the "production stock and demand record."

This provides a sheet for each part and shows not only each customer's requirements as to delivery but the exact condition of all of the parts of this kind. From the data on this form it is possible to tell quickly how much raw material for the part is in stock, how much is in process and how much is in finished stock. It tells in addition how many pieces have been rejected, how many reclaimed and how many scrapped. This is a most valuable form in other ways which will be discussed in more details in later articles on planning. A somewhat simplified form having the same application is shown in Fig. 13. It is self-explanatory.

So much for keeping track of the productive stores. The same forms and routine will do for the non-productive stores or supplies. One thing additional is worth considering with them, however; that is the need to prevent buying of supplies which are obsolete or the use of which is declining. This can best be done by the clerk who keeps the store's record. When he sees from his ledger sheet or card that the use of a supply is falling off he should call the fact to the attention of an executive.

Some shops find it well to have a committee on obsolescence which from time to time passes on the need for continued carrying of supplies.

Theoretically a minimum stock record or perpetual inventory will do away with the need of that bugbear—the taking of a complete physical inventory. But it seldom does. If the items are frequently counted and checked with the records, as I have recommended, it is often possible to keep the discrepancy within one per cent—and usually within 5 per cent. But that is not close enough. And after all, the goods in process must always be inventoried by actual count and it is that item usually which takes the time. Safety dictates that once a year all stock be inventoried and the records changed to agree with the actual.

The fact that it is so difficult to get perpetual stock records to agree exactly with the facts is one reason why so many manufacturers throw up their hands and look on the attempt to keep records as useless. That is wrong. Even an approximate record of the stock on hand is better than none—that is if the manufacturer wants to save himself production troubles.

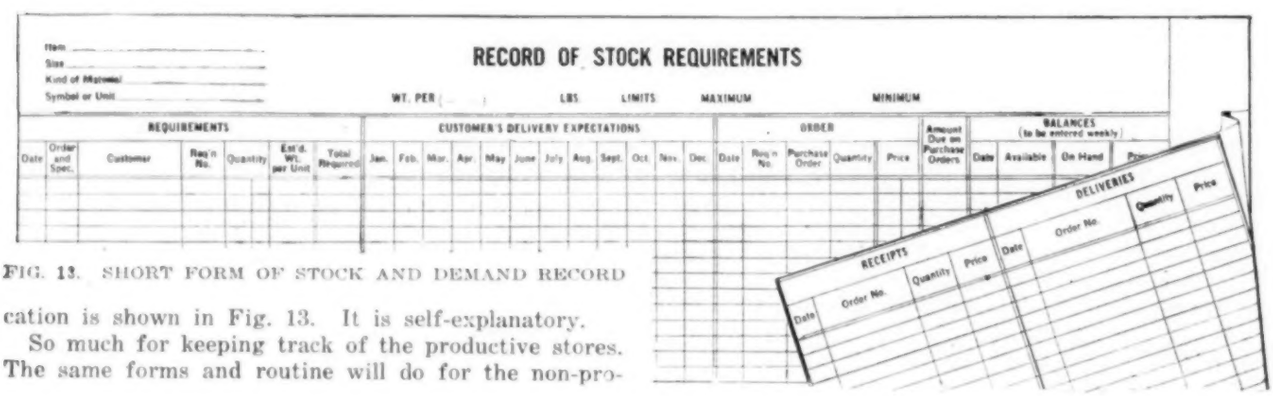


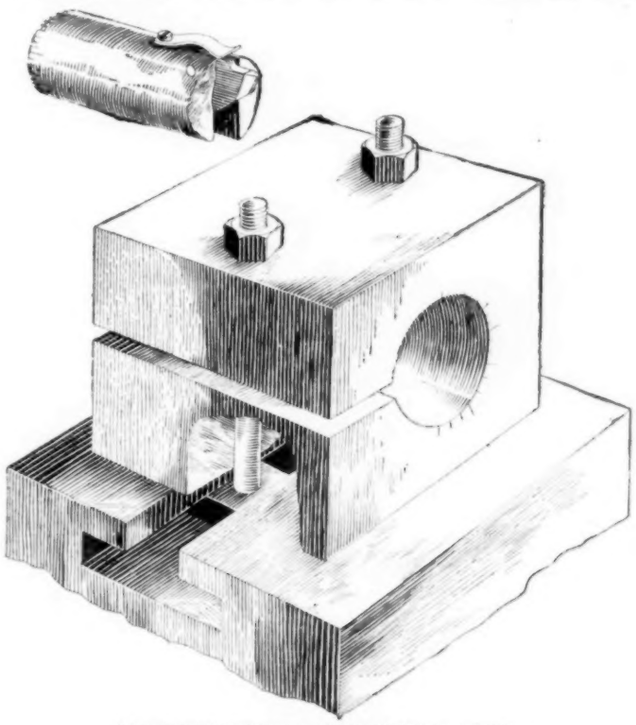
FIG. 13. SHORT FORM OF STOCK AND DEMAND RECORD

A Self-Relieving Thread Tool

By E. A. Dixie

In connection with the article under the title, "Cutting Screws of Quick Lead," published on page 883 of *American Machinist*, I want to illustrate a self-relieving tool which I designed for that purpose.

The body of the device may be made of cast iron or of steel as may be desired. It should have a rib to fit the toolpost slot of the cross-slide and two clearance holes for T-head bolts to hold it down. A hole through



SELF-RELIEVING THREADING TOOL

the center takes a round tool bar, and the slot at the side of this hole allows the bar to be tightened or released by manipulating one of the bolts while the other bolt remains tight to hold the body in place.

The edge of this hole may be graduated as shown and a zero line drawn on the tool bar to facilitate setting the tool to any desired angle of helix.

The business end of the bar is to be slotted and the actual cutting tool fitted to swing on a hardened pin as shown in the sketch. When the lathe is run back, this tool will lift in the same manner as the tool of a planer or shaper.

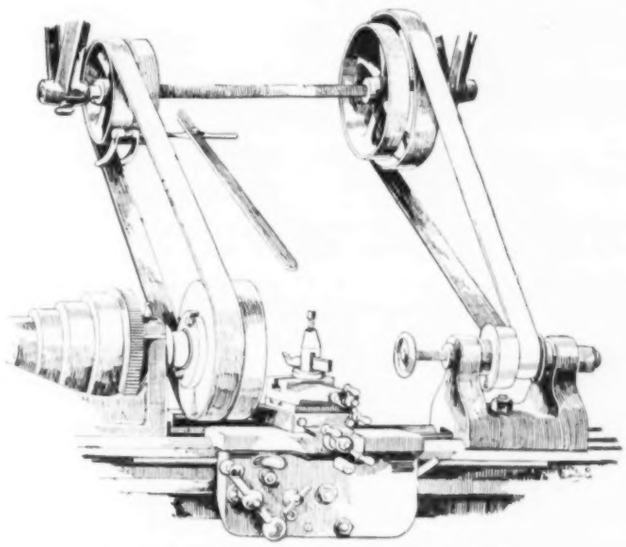
A small flat spring serves to return the tool to cutting position when set for high helix angles.

Speed Attachment for Engine Lathe

By H. H. Parker

A heavy lathe is not at all adapted to small work requiring high speed but is often used when no speed lathe is available. If there is much small work and it is not practicable to install a speed or bench lathe it would pay to make up a speed head, as suggested in the sketch, to be attached to the larger lathe when required. This head should be of the same swing so that the tailstock could be used.

The speed head should be planed to fit the ways



SPEED SPINDLE FOR ENGINE LATHE

and held by a bolt similar to the steadyrest. A hardwood straight-face pulley, bolted to a flange and screwed to the spindle nose, drives the speed spindle through a special light countershaft installed at any convenient location above the lathe.

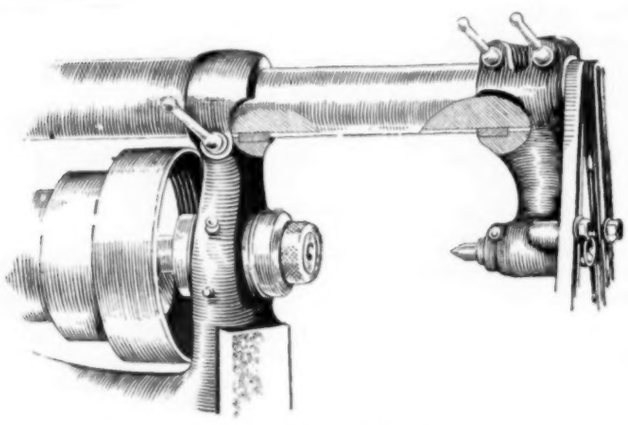
With only one pulley on the speed head, the latter, though speeded up, will have as many speed changes as the regular spindle and by providing it with two- or three-step cone the speed range may be doubled or tripled.

As small work frequently requires much stopping and starting the inertia of the heavy cone and spindle would be detrimental so a special control lever is provided, operating a belt shifter and tight and loose pulleys on the countershaft. This lever should be arranged so that it could be quickly turned up out of the way or removed when the speed head is not attached to the lathe bed

A Suggestion to Makers of Milling Machines

BY A. B. CHIARELLO

Through the columns of *American Machinist* I would like to suggest that the makers of milling machines put easily removable keys in the overarms and brackets



KEYING THE OVERARM

of their machines as shown in the illustration, to enable the operator to establish an accurate line-up when using very small arbors or boring bars.

Bulldozer Dies

BY W. B. GILBERT

It is not the intention of the writer to show the advantage of forming different shapes in wrought iron and steel on bulldozers, over forming them with hammer and anvil as in these days of accuracy and speed the advantage of machine over manual work is self-evident. It may not pay to make dies if the quantity wanted is very small and the order not likely to be repeated; yet bulldozer dies are usually very simple to make and their cost is so little that they will pay for themselves on a very small order.

Fig. 1 shows a cast-iron angle plate for mounting the female dies, the male die usually being bolted direct to the crosshead of the bulldozer. The dimensions may be made to suit any particular machine on which it is to be used. The tongue fitting between the ways of the bulldozer is a sliding fit. The angle at the back is used on the inside as a stop for the die and the backing screws of the machine are brought up against the outside, the length and width being made to suit the bulldozer on which the work is to be formed.

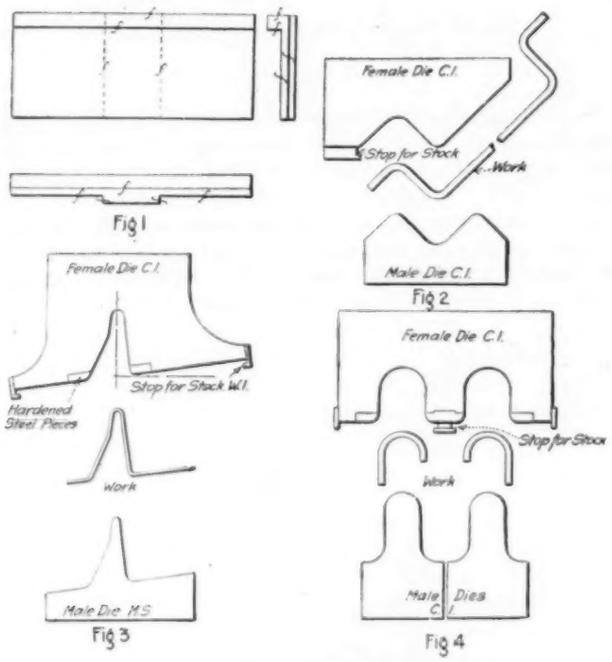
Fig. 2 shows a pair of dies for forming a wall bracket of ½ x 4 in. wrought iron or steel. Both dies are made of cast iron and the work is formed one end at a time, thus allowing for different lengths between the feet of the bracket, by forming first one end and then the other.

The female die is bolted to the angle plate shown in Fig. 1 and the male die is bolted direct to the crosshead of the bulldozer with tap bolts.

Fig. 3 shows an example of a well-designed pair of bulldozer dies. Instead of attempting to form this piece with the center line of the bulldozer parallel with the vertical leg, the faces of the dies are at an angle of 7½ deg., half of the 15-deg. angle at which the piece is to be formed. This arrangement divides the strain equally upon both sides of the dies. The female die is made of cast iron, machined on back and bottom and bolted to the angle plate, Fig. 1.

The stops for the stock are bolted to the ends of the die.

Hardened-steel wearing pieces should be set in, as shown, if the dies are to be used continually. The male



FIGS. 1 TO 4. BULLDOZER TOOLS

Fig. 1—Angle plate for holding male die. Fig. 2—Tools for bending wall bracket. Fig. 3—Equalizing strains in bending angle pieces. Fig. 4—Forming two pieces at once.

die in this case is made of machine steel and finished all over. It is bolted to the crosshead of the bulldozer.

Fig. 4 shows a pair of dies for forming pipe hangers of ½ x 2-in. wrought iron or steel. Both dies are made of cast iron, with hardened-steel wearing pieces set in the female die. The female die is machined on back and bottom and is bolted to the angle plate. The male dies are bolted to an angle plate, which in turn is bolted to the crosshead of the bulldozer, the back of the dies coming up against the crosshead. The male dies are machined on backs and bottoms. As shown in the cut, two pieces of work are formed at each stroke of the machine, the stock being cut off to length and placed between the stops provided.

The country job shop gets some strange orders at times. For instance, the other day a farmer blew into one such shop bringing with him a large flat-iron with the handle busted off. He wanted a wedge for splitting logs and thought that our blacksmith could forge this useless chunk of cast iron into such a wedge, thereby saving him the cost of material.

WHAT to READ —for the man in a hurry

Suggested by the Managing Editor

IN OTHER issues since the first of the year we have had quite a little to say about the multiple drilling machines of the Foote-Burt Co. Our leader this week takes up the tapping machines of the same concern which have proved to be a valuable contribution to our supply of manufacturing machines. There are two important technical articles in this issue, the first of A. J. Langhammer's series on the testing of high-speed steel, on page 979, and the eleventh article of Prof. Furman's cam series on page 987. The former article is also being run in *Chemical and Metallurgical Engineering* and the editors of that paper have checked up the chemistry which appears therein. As to the cam article, you can't afford to miss it if you have been following the series. On the other hand, we would hardly advise anyone to start in on it at this point without having studied what has gone before.

Nobody who is holding down a man's job has time to read all of the "American Machinist." On the other hand there are some articles in every number that you can't afford to miss. We are running this page to save your time by pointing out the articles in this issue that are aimed at men holding jobs like yours. Read the editorials —they are short and to the point. The "Sparks" will give you the latest news of the machine industry. The "Shop Equipment News" columns show the innovations in tools and methods.

Somebody has said that the successful executive is the man who gets some one else to do his work for him. According to that definition we are one, for part of this week's work has been done admirably for us by the gentleman whose letter appears in the panel on this page.

What would be the results of a compulsory metric law on everyday life? Read Raymond F. Fletcher's humorous account on page 985. On page 1014 the Army deals a body blow to the World Trade Club. After a thorough trial of metric units during the war, a general order has been issued directing the return to the inch system except in certain specialized branches. Prof. Park adds his work of condemnation on page 1000 and from an entirely different viewpoint.

Every man who is employing other men is facing at this time the stiff problem of keeping up interest, maintaining morale, getting production or whatever else you choose to call it. On page 983 Dr. Kitson gets at the question from the point of view of the psychologist. Sounds high-brow, but there are some real ideas mixed in with it that are worth noting.

Whatever else the average automobile repair mechanic may be he is seldom an expert machinist. If you have a small shop and have been bitten by the garage bug, read Donald A. Hampson's words of warning on page 1001 and stop and consider before doing anything rash. While we still have a little space left we must mention Part III of "Modern Production Methods." This takes up stock-keeping and the stockroom and points out the common tendency to save at the spigot and waste at the bung.

Detroit, Mich., April 26, 1920.

Ethan Viall, Editor,
American Machinist,
10th Avenue at 36th St.,
New York, N. Y.

Dear Sir:

Please accept my congratulations upon your new style of handling automotive articles.

The grouping of the practices of different manufacturers is the only practical way for studying them. Heretofore the writer has been obliged to do his own grouping and this has not always been handy.

Very truly yours,
F. E. WATTS,
Chief Engineer,
HUPP MOTOR CAR CORPORATION.

As we go to press things in the machine-tool business in Cincinnati are in a very unpleasant mess because of the action of certain radical agitators. We feel rather strongly on this point and hope that our position as stated on page 1012 will be thoroughly understood. Viall has gone to the seat of the disturbance to be on the ground and watch developments at first hand. His statement is a result of his impressions.

To show that we in this country have plenty of company in our industrial misery you have only to read the letter from our London correspondent on page 1018. He points out the feeling of insecurity that persists and calls attention to the almost universal decline in productive efficiency. From raw material supply to the finished product he reports a general slowing down.

A Stand for Industrial Americanism

THE largest machine-tool building center in the world is now facing a crisis that affects the entire manufacturing industry of the United States.

On numerous occasions radicals have threatened to "get" Cincinnati—very likely because machine-tool building is a key industry—the backbone of our entire industrial system.

Now a large number of machine-tool shop workers in Cincinnati are on a strike for a large increase in wages and a minimum wage scale. But—NOTE THIS—the shop men THEMSELVES made no demand on their employers, the demands being made by OUTSIDE PROFESSIONAL AGITATORS assisted by ONE RADICAL resident professional agitator!

Since 1915 the cost of living in Cincinnati has gone up the same as it has everywhere else, but the figures to which we have access show that wages have been voluntarily raised as the living cost increased—IN FACT, THE PERCENTAGE OF WAGE INCREASE HAS BEEN CONSIDERABLY GREATER THAN THAT FOR LIVING EXPENSES. The output, per man, however, has steadily DECREASED.

Regardless of the cause of this trouble in Cincinnati, the employers would pay increased wages PROVIDED production was in a normal condition—but—IT ISN'T.

Isn't it time that demands for more pay for less production were stopped? Have some lost their sporting instinct and are trying to shift it all onto others rather than to do their parts on the great Union team, and play their positions to the best of their ability? No one should forget that if he loafs on his job he adds to the High Cost of Living of others as well as himself.

Without the professional agitators the sober thinking men could easily see things from a rational standpoint and come to an understanding with their employers.

The employers are not fighting the union as such, nor its conservative members, but they ARE fighting the professional agitators.

All Americans—and especially other American manufacturers—should support the Cincinnati employers in their fight to eliminate the radical elements—ELEMENTS WHICH ARE JUST AS DANGEROUS TO THE WORKER AS TO THE EMPLOYER.

If the professional agitator is successful in this case, the way is open for him to attack other cities.

Already far behind on their deliveries of machinery, the Cincinnati machine-tool builders need assurance from their customers that they will give them complete moral support.

Cancelled orders mean a weakening of the resources of the men who are making a fighting stand for Americanism and for YOU. Back up the fighters!

Thos. Viall

Editor

What Other Editors Think

Opposes Adoption of the Metric System

FROM *Iron Trade Review*

IN a new edition of the book entitled "The Metric Fallacy," the author, Frederick A. Halsey, commissioner of the American Institute of Weights and Measures, outlines the result of an investigation of the claims made for the metric system and especially of the claim that its adoption is necessary in the interest of the export trade. Chapter I is devoted to a brief history of the metric system in France. Metric standards were made compulsory by a drastic law in 1793 and remained in force 19 years, or until 1812, when Napoleon, who had no faith in the system, had the law repealed. Under the relaxed laws, the people immediately reverted to the universal system in which twelve inches makes a foot, and continued the practice for 25 years, or until 1837, when the metric enforcement laws were reimposed, continuing in effect until the present day.

In Chapter II, the replies to 500 questionnaires distributed in South and Central America and the West Indies indicate that the metric system is not used extensively in Latin America. The results of the questionnaires are tabulated in the back of the book. In but one country, Uruguay, can the metric system be said to be adopted for domestic trade and from this country answers were received to the effect that while the metric system was official, the English system was customary and no effort has been made to abolish the latter system.

In substantially all of the countries investigated, the English inch is used for mechanical purposes and the English nautical units are used for navigation and sea shipments. That most derided of English units, the nautical mile, is used by all countries that sail the sea and they use no other. In machine shops both English and metric units are used, depending chiefly on the country of origin of the machines they have to repair, but the inch is predominant.

Another chapter is devoted to arguments against the claim that the metric system is necessary in the interest of foreign trade. A summary of the replies to questionnaires submitted to American exporters shows that of 1,445 replies, 1,189 did not use the metric system; 160 used it slightly; 29 used it considerably; 16 used it extensively; 5 used it exclusively and 46 did not reply.

One manufacturer reports that 95 to 100 per cent of his tools shipped to South America are made to English unit specifications. Referring to engineering standards, it is stated that although the metric system is used to a limited extent in American engineering practice today, its adoption for exclusive use would mean the revision in practically every industry. No manufacturing nation has ever attempted to change its weights and measures and the United States and Great Britain are the only such countries in which the change has been proposed.

Iron Castings in Iron Molds

FROM *Chemical and Metallurgical Engineering*

EVERY so often the question pops up, "Why are not permanent molds more widely used for iron castings?" The questioner may have in mind the great success of die casting as applied to white metal alloys or more recently to the more difficult aluminum bronzes; or he may have a recollection of having heard that such a procedure has been or could be applied to the iron foundry.

Perhaps the usual answer if the question were put to the "old-timer" would be that chill castings would have a heavy skin of white iron and the machine shop could do nothing with them. The answer would be entirely correct, and could be substantiated at any time by pouring a little of the iron regularly coming from the cupola and destined for green sand into a pig mold.

The depth of the white-iron shell might even be intensified by filling a heavy deep iron cup. Examination of this sample when fractured would immediately show whether there was any possibility of a die-cast piece being machinable, a test used by Outerbridge for over thirty years. It was he who discovered and put to thorough commercial application a long time ago the fact that if the metal possessed the correct composition, either by original melting or by ladle additions of ferromanganese and ferrosilicon, such a chill cup would not produce even the thinnest skin of white iron, and a properly designed mold would give a commercial casting, soft and strong, very fine grained, almost steel-like in appearance after machining, yet having practically no combined carbon at all. He first set chill blocks in sand molded gear wheels, so that the rate of solidification could be so controlled that an accumulation of deep-seated cavities would not appear at the arm-junctions. From that point, progress naturally suggested a like practice on lathe beds, where dense sound iron is requisite.

If correct iron could cool against a series of blocks set in supporting sand without developing hard spots in the casting, there seemed no reason why the entire mold should not be made of iron, even to any necessary cores.

Outerbridge did it, and has made over a million castings in iron molds, machinable castings of exceedingly fine grain, free of dirt, sponginess and other defects, and having a marked increase in strength over the sand-cast metal. In this work the cores were withdrawn quickly to prevent seizure, but the casting cooled black in the mold.

This work at the Sellers foundry was kept a close secret for many years, with only bits of information leaking out from time to time. Therefore later work was along independent lines and without advantage of the accumulated experience at this particular foundry.

Annual Convention of the Chamber of Commerce of the United States

With headquarters at the Traymore in Atlantic City and ramifications that extended to most of the other big hotels in the convention section, the Chamber of Commerce of the United States held a successful and enthusiastic convention on April 26, 27, 28 and 29. The number of delegates present was variously estimated at from three to five thousand and the excellence of the speakers was attested by the attendance at the meetings. The correspondent can vouch for the truth of this statement for he sat for three hours on the hard floor of the Belvedere Room of the Traymore and considered himself lucky to have obtained a piece of floor big enough to sit on. Many men stood throughout this session. It was only a group meeting, but those who were fortunate enough to be there, found it to be the high point of the convention.

The general subject was "Industrial Production" and the keen interest of every one in this topic was illustrated by the representatives of the business men of the country. Exactly the same interest has been displayed at most of the engineering society meetings of the past year and augurs well for the chances of working out a successful solution of our present difficulties. Chairman Charles F. Lang, of the Lakewood Engineering Co., presided and the speakers were Dr. Charles A. Eaton, of *Leslie's Weekly*, Rumsey W. Scott, of the Otis Elevator Co., Pomeroy Burton, Managing Director of the *London Daily Mail* and the Hon. Henry J. Allen, Governor of Kansas. Great stress was laid on the need for educating both employer and employee, and the supreme importance of supplying better leadership than that offered by the radical labor leaders was dwelt upon. Governor Allen described the events leading up to the founding of the Kansas Industrial Court and discussed its operation in the three months since it was formed. He brought out the facts that this court has done more for the coal miner in three months than his organization leader had done in thirty years and that eleven out of twelve decisions handed down in that time had been favorable to labor.

In answer to the claim of the radicals that all union labor would gradually leave the State of Kansas he gave it as his opinion that many of the radicals would, but that for each radical that left, two conservatives would come in, and that eventually much new business would come to Kansas to take advantage of the conditions existing under the new law.

It would take many issues of the *American Machinist* to begin to give an account of all that was said and done in the general sessions and the many section meetings. Suffice it to say that the following named sections had one or more meetings and did much business: I, Railroads; II, Shipping; III, Cost Accounting; IV, Foreign Commerce; V, Finance; VI, Domestic Distribution; VII, The Business and Daily Press; VIII, Highways; IX, Industrial Production; X, Civic Development; XI, Insurance; XII, American Committee on International Chamber of Commerce.

Most of the work done on Monday was of a preliminary nature and was followed by a buffet-dance and smoker in the evening: Tuesday morning was devoted to reports and address of President Homer L. Ferguson. The Tuesday evening session was enlivened by the presentation of inside and outside views of the Federal taxation by Daniel C. Roper, Ex-Commissioner of Internal Revenue and George T. Buckingham of Chicago. Secretary of Commerce Alexander and George E. Roberts of the National City Bank also made addresses.

Wednesday morning was given over to transportation, the parts played by the railroads, the electric railways and the motor truck being presented by Messrs. Post, Pardee and Graham. Admiral Benson spoke on the merchant marine. On Wednesday evening the delegates had the pleasure of listening to the first public speech of the new British Ambassador, Sir Auckland Geddes, who painted the plight of the European continent in none too glowing terms. Other speakers were James H. McGraw, President of the McGraw-Hill Co., Inc., on the "Functions of the Business Press in Relation to Production;" Secretary of Agriculture Meredith; J. H. Howard and C. C. Parlin. H. A. Wheeler made a report for the building committee and spoke of the purchase of a plot on Connecticut Ave. and H. St. in Washington and of plans to erect a two-million-dollar home for the Chamber at once.

On Thursday morning the relation of labor and immigration to production were presented by Matthew Woll, vice president of the American Federation of Labor; John W. O'Leary of Chicago and Charles Nagel, former secretary of Commerce and Labor. Governor Allen spoke again at this meeting which turned out to be a rather warm session when many of the delegates disagreed audibly with Mr. Woll's statements.

The representative of organized labor made the mistake of talking too long at a closing session. This irritated many of his listeners almost as much as some of his statements and they called "Time!"

Army Order Limits Units of Weights and Measures to English Standards

British units of weights and measures are to be used as far as possible in the Army according to an order from the Chief of Staff issued April 28. The Chief of Staff in his order states that the Secretary of War has ordered that the following policy will govern the use of weights and measures by the Army:

"As an incident to the World War metric units of weight and measure necessarily were used in instruction and training. As a result more or less confusion now exists as to what units should be used normally. Hereafter the customary former units of weights and measures (including the degree Fahrenheit) will be used, as far as practicable, throughout the Army, as they were before the war. Material and equipment now graduated in metric units, when worn out, will be replaced by articles graduated in British units in such manner as will cause all parts of a regiment or similar organization (or smaller organization when there is no regimental organization) to be provided at all times with material and equipment graduated alike.

"This order shall not be construed to prevent the utilization of metric units of weight and measure when desirable in connection with specifications and contracts, medical and scientific supplies, scientific and research developments, international meteorology, foreign maps, monographs, handbooks, and similar subjects."

SHOP EQUIPMENT NEWS

-Edited By-
E. L. DUNN and S. A. HAND

SHOP EQUIPMENT • NEWS •
A weekly review of modern designs and equipment

Descriptions of shop equipment in this section constitute editorial service for which there is no charge. To be eligible for presentation, the article must not have been on the market more than six months and must not have been advertised in this or any previous issue. Owing to the news character of these descriptions it will be impossible to submit them to the manufacturer for approval.

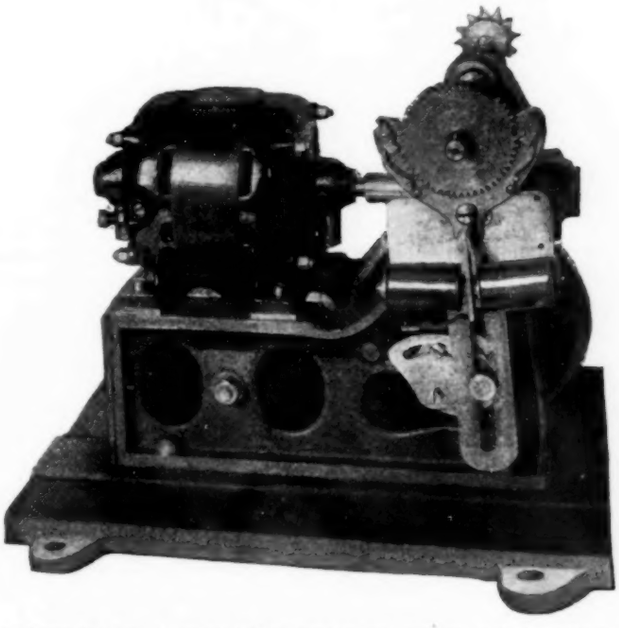
• CONDENSED • CLIPPING INDEX
A continuous record of modern designs and equipment

Engelhard Automatic Temperature Regulator

Charles Engelhard, 30 Church St., New York, has brought out the automatic temperature regulator illustrated herewith.

The motor, through worm gearing and a wrist pin, keeps the slotted link shown, in constant vibration. As the link is pivoted on the upper shaft and carries a yoke on which are mounted two pawls, the pawls must also vibrate about the ratchet wheel also attached to the upper shaft. Connection with the valve to be opened or closed is made by chain from the sprocket wheel on the rear of the upper shaft to a sprocket wheel on the valve stem. It will thus be seen that if one of the pawls be engaged with the ratchet wheel the upper shaft will be intermittently revolved, imparting the motion to the valve stem and the valve will be either opened or closed according to which one of the pawls is engaged. The pawls are controlled by oppositely located electromagnets in circuit with a pyrometer having two plate contacts beneath the pointer, one on each side of the dividing line. A depresser bar located within the instrument and over the pointer and controlled either by clockwork or a solenoid magnet is allowed to fall at predetermined intervals.

The pointer carries a small pin at a right angle to its longitudinal section and it will be understood that when the depresser bar forces the pointer down this pin completes the circuit between the depresser bar and one or the other of the two plates beneath, depending on whether the pointer is above or below the dividing line. The circuit thus completed is passed through one or the other of the electromagnets according to the plate with which contact is made.

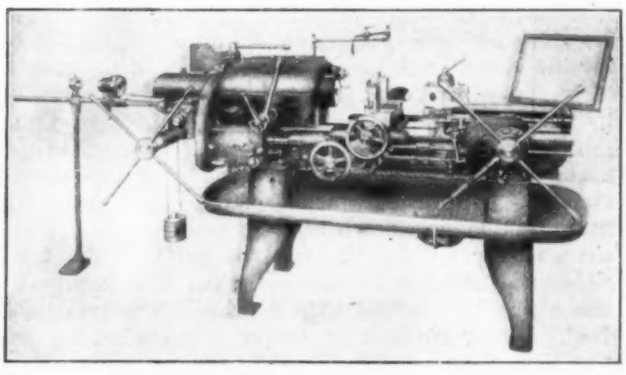


ENGELHARD AUTOMATIC TEMPERATURE REGULATOR

Herbert Universal Turret Lathe

One of the turret lathes manufactured by Alfred Herbert, Ltd., Coventry, England, is here illustrated. It is shown at the company's showrooms, 54 Dey St., New York City, and is made in one size only, known as No. 4. It is designed for both chuck and bar work. The single pulley head provides eight speeds in either direction and can be supplied with or without the geared draw-in chuck and automatic feed for bars. The automatic bar feed furnished with the draw-in chuck is of simple design and is operated by an adjustable weight.

The tailrod carries an adjustable, ball-bearing revolving carrier which avoids the necessity for using feeding collars for every size of bar. The hexagon turret may be rotated automatically or by hand. The turret slide carries a hexagon stop bar geared to rotate with the turret and is provided with six adjustable stops, which trip the feed and act as dead stops. The square turret for the cross-slide and the taper attachment are furnished as extras, the former is recommended for chucking work.

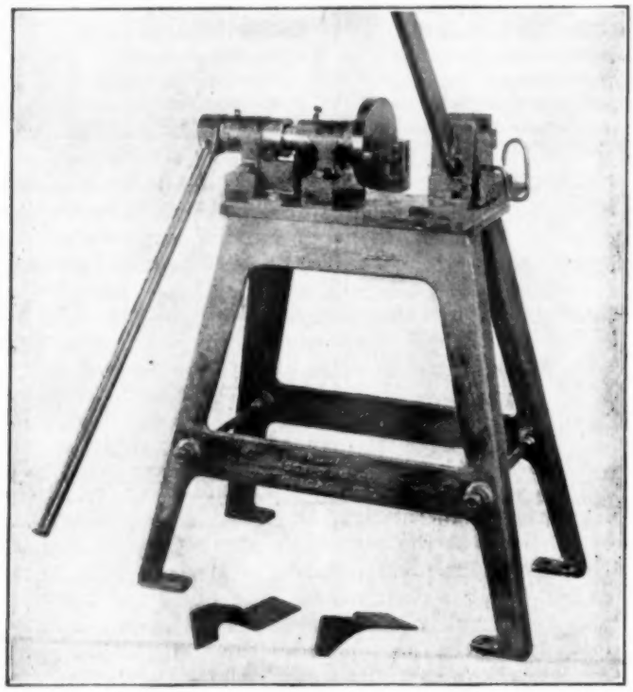


HERBERT UNIVERSAL TURRET LATHE

Specifications. Draw-in chucking capacity, 1⅝ in. Spindle hole capacity, 2 in. Working stroke of turret, 9 in. Spindle speeds, 8. Hp., 5. Pulley, 8 in. Belt, 4 in. Swing over cross-slide, 6¼ in. Automatic feeds, 4. Tool holes in turret, 1¼ in. Net weight with plain head 2,256 lb. With draw-in chuck and bar feed 2,460 lb.

Wallace Bar-Twisting Machine

The Wallace Supplies Manufacturing Co., 412-420 Orleans St., Chicago, Ill., has recently put out the bar-twisting machine shown in the accompanying illustration. This machine has been designed for giving a quarter twist to the ends of flat bars; and it is arranged for offsetting the stock in such a manner as to leave one edge of the twisted end of the same plane as the flat side of the bar, instead of merely twisting about

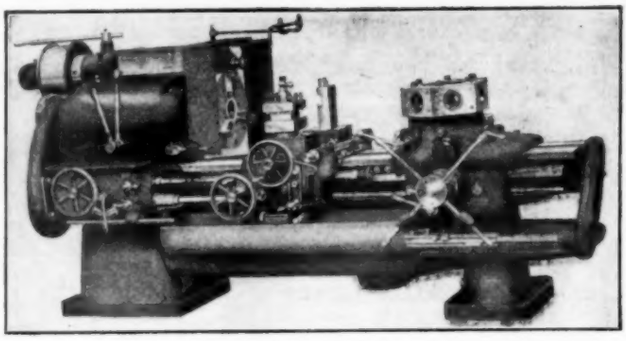


WALLACE BAR-TWISTING MACHINE

the center of the bar as an axis. Twisted pieces are shown below the machine. Either hot or cold bars can be twisted, the necessity for heating being determined to some extent by the size of the bar. These machines are made to order only.

Herbert Combination Turret Lathe

The turret lathe shown is one of the types manufactured by Alfred Herbert, Ltd., Coventry, England; New York sales offices, 54 Dey St. The machine is made in three sizes, Nos. 3, 9 and 20, the No. 9 size being illustrated herewith. The single-pulley drive through friction clutches and sliding gears provides eight speeds for the No. 3 machine and sixteen speeds for the two larger machines. The turret slide is guided on the bed by the front shear only, and is clamped by a long taper gib moved endwise by a hand lever. The turret-slide apron provides feeds in each direction, six self-selecting stops being furnished which also act as dead stops. The gears in the apron are all of steel or bronze and a change gear enables the relative feeds of the turret slide and saddle to be changed when it is required to use a fine turret feed with a relatively coarse saddle feed. Power rotation of turret is provided for both the Nos. 3 and 9 lathes by depressing a hand lever at the front of the slide. A device is furnished for adjusting the two stop bars for the saddle and turret slide in unison along the bed to accommodate varia-



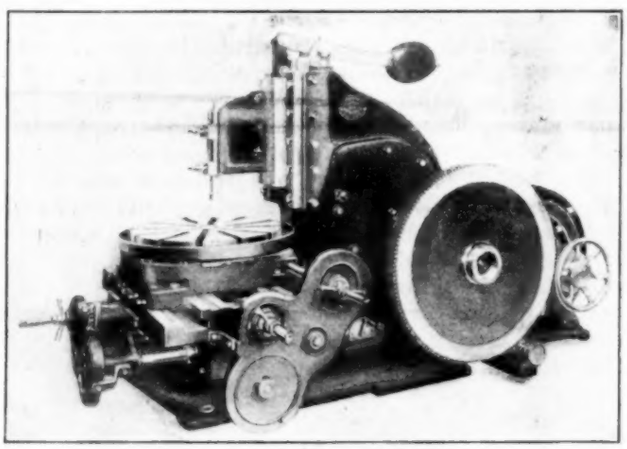
HERBERT COMBINATION TURRET LATHE

Specifications. Sizes Nos. 3—9—20. Swing over beds, 16½ in., 20 in., 28 in. Swing over cross-slides, 8⅞ in., 12⅝ in., 18 in. Holes through spindles admit, 2¾-in., 3½-in., 4½ in. stock. Driving pulleys, 10 in., 12 in., 14 in. Belts, 5 in. Hp. 7—8—10. Net weights, 5,280—6,680—11,050 lb.

tions in the thickness of the articles being machined. The stop bars in the No. 9 lathe are adjustable independently. The taper attachment will deal with internal or external tapers, and taper threads can be chased as easily as parallel threads.

Muir Slotting Machine

Alfred Herbert, Ltd., 54 Dey St., New York City, is the selling agency for the English-built machine here illustrated and known in England as a "Puncher Slotting Machine." It is claimed this machine can remove continuously 18 cu.in. per minute of steel of 60,000-lb.—tensile—strength and do so with an ample



MUIR SLOTTING MACHINE

reserve of power. The machine is specially recommended by the makers for the gapping of cranks, and the tooling of deep work beyond the scope of the milling machine. The table is solidly mounted on large square slides provided with adjustable gibs. The stroke can be quickly changed and the toolholders are supplied in a variety of forms to suit a wide range of work. The machine is built in four sizes, the maximum stroke for each size being respectively 8½, 12½, 15 and 18 in. The table diameters range from 27 to 42 in. and net weights from 12,100 to 33,000 lb.

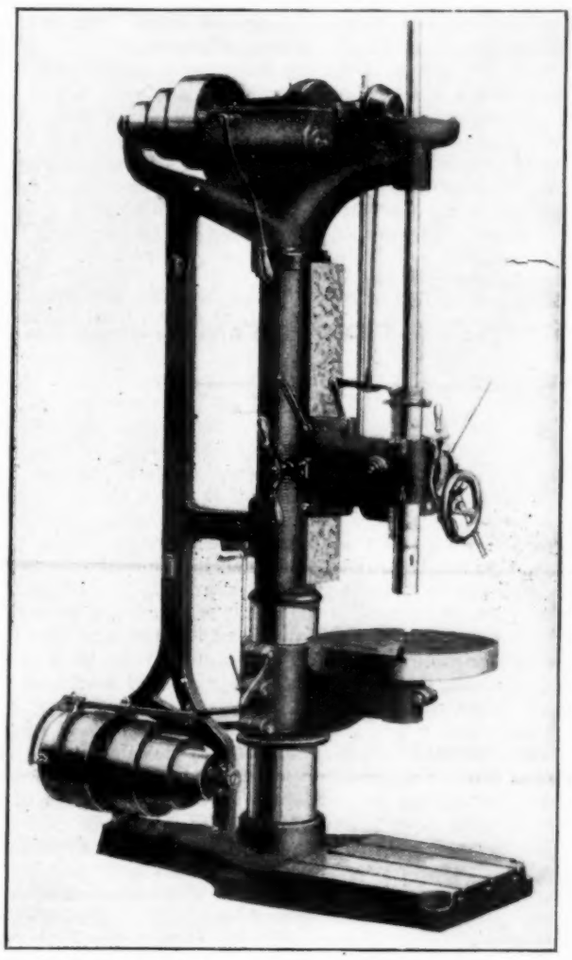
Hess "Tinol" Soldering Paste

Hess & Son, Philadelphia, Pa., have recently put on the market a special soldering paste known as "Tinol." They especially recommend it for soldering cast iron.

When applied to cast iron the volatile part of the paste evaporates when heated and leaves behind a thin coating of bright tin to which solder readily adheres. The paste will not injure silk insulation on electric wires, nor will it attack the metal, but it has the property of removing oxide.

Sibley 26- and 28-In. Sliding-Head Drilling Machines

The Sibley Machine Co., South Bend, Ind., has added to its line 26- and 28-in. drilling machines of the sliding-head type, one of which is shown in the accompanying illustration. The general description and



SIBLEY SLIDING-HEAD DRILLING MACHINE

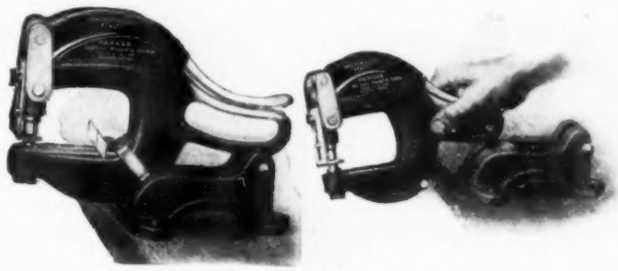
specifications of the 26- and 28-in. machines are the same as those of the 24-in. machine, published in the *American Machinist* Nov. 13, 1919, except in swing and size of tables, which, of course, add somewhat to the weight.

Parker No. XX Combination Punch

The combination punch shown is a product of the Parker Supply Co., Inc., 785 East 135th St., New York City.

It may be used as a hand tool or bench tool, as it is quickly detachable from the bracket that is screwed permanently to the bench. The open jaw and wide throat will accommodate work that has rolled or formed edges.

It is equipped with a polished-steel gage for spacing parallel holes and a stripper adjustable to position, or that may be removed when not needed. The tool is made of drop-forged heat-treated steel, with



PARKER NO. XX COMBINATION PUNCH

working parts hardened. It measures 9 in. in height, weighs 4½ lb., and will punch a ⅜-in. hole in 20-gage steel, or the equivalent.

No. 1 Grand Rapids Tap-Grinding Machine

The machine illustrated herewith is an addition to the line of the Grand Rapids Grinding Machine Co., and is designed for grinding the tapers on the ends of taps. It will grind plug taps from No. 6 machine-screw sizes to 1 in. and also taper taps where the length of taper does not exceed 1¼ in. Taps with or without centers can be ground, the former on centers, the latter being held at one end in a chuck and at the other by a female center. The angle of the taper is adjustable so that taps either with a short or long taper can be ground. Either right- or left-hand taps can also be ground.

NO. 1 GRAND RAPIDS TAP-GRINDING MACHINE

In grinding, the tap is held in a horizontal position and the work is done by the periphery of the wheel. The principle of the operation is, that the axis on which the tap is swung, is offset from its working axis an amount sufficient to provide the desired angle of clearance.

A countershaft and diamond truing device, together with a diamond, are included in the standard equipment.

Business Conditions in England

FROM OUR LONDON CORRESPONDENT

London, April 9, 1920.

IMMEDIATELY preceding the Easter holidays two items of importance were announced. One was a statement of revenue and expenditure in the United Kingdom during the last fiscal year, which ends with the month of March. The total revenue for the year was £1,339,571,381, or more than £450,550,000 in excess of that for the preceding year. The expenditure amounted to £1,665,772,928, which again is about £913,528,000 less than for the preceding year. Thus, a deficit of £326,201,547 is disclosed. The revenue is without precedent and the deficit, while about £76,000,000 in excess of that estimated at the time of the introduction of the budget, a year or so ago, is £147,000,000 less than was predicted by the Chancellor of the Exchequer about five months before.

Whatever satisfaction may be felt from the result must be discounted by the fact that, included in the revenue, is a sum, the exact amount of which is undisclosed, derived from the sales of war properties. It has long since been pointed out that these are assets or capital and that their sale does not produce true revenue. The excess profits duty brought in about £290,000,000 and much remains to be collected in this direction, even at the reduced rate of the past year. As to the future, it is sufficient to say that the next budget will be introduced, it is expected, on April 19.

The Findings of the Court of Inquiry

The other matter relates to the findings of the court of inquiry set up to investigate the employment of dock laborers, etc. It may possibly have an even more lasting influence on Great Britain. Here for a number of years statistics have been gathered and digested on the state of employment, and more particularly on the proportion of unemployed workpeople in any given period. Official returns have been published regularly, month by month. They have disclosed the fact, now pretty well known, that however good may be the conditions of trade, men in considerable numbers were unemployed.

Apologists for existing conditions always hold that such a reservoir of labor is necessary from the employing point of view; probably no argument has been so effective as this in setting workmen against present systems. Insecurity has been the prevailing feeling. An attack, mild in its way, was made on the operation of this theory when the government employment insurance act was introduced for engineering, shipbuilding and building trades, these being the three industries held to be most liable to employment fluctuation. Contributions are made by the workpeople, by the state and also by the employer, the call on the latter being on the ground that he benefits from the said reservoir of labor and should therefore contribute to its upkeep.

A System of Registration of Dock Labor

Now the same point of view is seen in the majority report issued in connection with the dockers' inquiry. The words used are: "In one sense it is a convenience to authorities and employers, whose requirements are at the mercy of storms and tides and unforeseen casualties, to have a reservoir of unemployment which can be readily tapped as the need emerges for a labor supply. If men were merely the spare parts of an industrial machine, this callous reckoning might be appropriate: but society will not tolerate much longer the continuance of the employment of human beings on those lines." A system of registration of dock labor is to be introduced and, in accordance with the above quotation, the principles of maintenance of unemployed labor of casual character is approved. Dock labor is to be paid weekly, and bodies of a Whitley character are, it is recommended, to be set up. Further, "with a view to establishing a national minimum standard" a rather high minimum for day workers and piece workers is recommended.

A minority report, signed by two of the nine investigators, suggests the unsettling effect of the special rates proposed for other classes of labor.

The decline in the effort of the worker is fairly general. Thus, at the annual general meeting of the Metropolitan-Vickers Electrical Co., Ltd. (which will perhaps be better known to American readers by its former title, the British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park), the chairman held the diminished output of labor, with increased cost of materials and difficulties of transport, responsible for the fact that the firm is not turning over capital as often as formerly. Then of course increased volume of business means more plant and buildings, calling for largely increased investment. In addition is the difficulty in obtaining labor to work new machinery, etc. At the Westinghouse works, at any rate, a large drop in output per man is reported. The lessening of the weekly working hour is held to be a direct influence. It is a fairly general experience that, whatever may have been the case previously or in experimental instances, now as a rule the shortening of the working day by reduction in hours not only is not compensated for but the output per hour worked is lower.

A Temporary Increase in Production

There have been cases where with the introduction of the 47-hour week, the output increased. The writer recalls one machine-tool firm where the increase was at first about 10 per cent. A spurt had added to the pace, but in a few weeks this had disappeared and the output was lower and slowly diminishing. To return to the Metropolitan-Vickers Co., the chairman was of the opinion that "the lion in the path was suspicion—suspicion of labor in the mind of capital, suspicion of capital in the mind of labor. Suspicion is bred of fear; fear is bred of ignorance." The remedy suggested for this distrust is identification of interest; that is, payment by results or profit-sharing. The effect of suspicion was suggested in the result of the action of the directors in setting aside £100,000, of an issue of a million shares, for subscription by the firm's own employees, with provision for advances on easy terms. Only £10,000 worth of shares were taken up by the workpeople. The company, by the way, showed a profit of £320,659 against £246,575 in 1918. Orders received during 1919 exceeded those of 1918 by about 20 per cent. Orders received during the first two months of the current year had about three times the value of those taken in the same period of 1919.

To return to the new unemployment bill, a deputation of the Federation of Professional and Administrative Workers, representing, so it is said, about a score of associations and some quarter of a million members, waited recently on the minister of labor in order that the case of the brain worker rather than the manual laborer might be placed before the government. It was claimed that associations providing better benents voluntarily should have the right to contract out of the act. Further, the fact was stated that as regards professional, etc., workers standard rates of pay did not as a rule obtain; therefore the safeguards proposed against disqualification if a man refuses a job at less than standard rate hardly apply. Equal contributions and benefits were claimed for men and women. A new association, by the way, has just been formed to combat the notion that for equal work the woman teacher is entitled to equal pay with the male teacher.

Coal Supply Unsatisfactory

Special attention was drawn here a few weeks ago to the unsatisfactory coal supply. As to the Bradford district, it is asserted that in many cases it was only possible to obtain 75 per cent of the full-load capacity in steam-raising plants, whereas with better coal it would have been possible to get

overloads of 10 to 20 per cent. The cause was the poor quality of fuel available, this resulting from unsatisfactory screening and washing and from the operation of price limitation which withheld any inducement to collieries in the way of extra profits, to add to labor and other expenses in this direction.

Increase of Coal Output Not in Sight

The hopes of increase in the coal output entertained a month or two ago have not been fulfilled and rather less than five million tons a week is still the figure. On the one hand, the miner is blamed; on the other, want of appliances and transport troubles are adduced.

Reference was recently made to the way in which engineering firms are insuring supplies of raw material by acquiring shares or otherwise obtaining control in steel and other firms. The latest announcement has a reference to the joint action of Sir W. Beardmore, and of Swan, Hunter & Wigham Richardson, Ltd., the shipbuilding and marine engineering concern of Wallsend, who have purchased the shares of the Glasgow Iron and Steel Co. and acquired the Blaydon Iron Works, the purpose being to secure a foundry, a supply of steel plates, etc. The capital of Swan-Hunter is to be raised to £9,000,000 but at present no public appeal is to be made.

The steel output in Great Britain, largely augmented during the war, is again increasing, though much has yet to be recovered. Some thirty-five years ago the output of Great Britain exceeded that of America, whereas even in 1918 when the British output totaled some 9,700,000 tons, the American output, as stated in Great Britain, was 36,400,000 tons. The present rate of British steel production is apparently nearly 25 per cent in advance of the 1913 rate.

As part of the new move to insure increased efficiency in works and offices a National Institute of Psychology and Physiology is being formed. It is supported by many industrial leaders. A research laboratory is to be equipped to deal with problems of output and fatigue, and an annual income of £6,000 is regarded as the minimum on which to start work. The new institute will work in connection with the Industrial Fatigue Research Board and the laboratory and library will be in common.

Demand for Materials Exceeds Supply

The supply of engineering materials is, generally speaking, nowhere near the demand and this relates particularly to steel plates, sheets, etc. The foundries have in no sense caught up, and the working of overtime is highly restricted or, as is more generally the case, refused by the workpeople.

Notwithstanding, for example, the serious plight of Great Britain and the problem presented by the lack of houses, building-trade workers in the Manchester district have refused to put in an extra hour a day as overtime, though before long the ordinary weekly working period will be reduced from 48 hours to 44. All branches of the engineering and machinery-building industry have more orders than can be met, price apparently being even less than a secondary consideration with present-day customers.

A Contract for 200 Locomotives

It is stated that Armstrong, Whitworth & Co., Ltd., have received a contract from the Belgian government for the supply of 200 locomotives, which will be built in the firm's Scotswood works to the designs of the Belgian state railways administration. In Great Britain this has been regarded as the largest order of the kind ever given, and, according to a statement that has been issued, the value is said to approach £3,000,000.

The prices of machine tools have lately been advanced by 5 per cent and a further advance is anticipated in the course of about two months. This is not expected to handicap the machine-tool builder. To take an instance from the knowledge of the writer, a firm having informed one of its customers buying in quantities for resale that an increase in price would shortly be made, the firm of merchants wrote back protesting and cancelling the order, which was of considerable proportions. The machine-tool firm accepted the cancellation, but was immediately told that the order was not cancelled but postponed. Nevertheless, cancellation was insisted on by the builders. They will have no difficulty in finding other customers. Any ning that exists can be so

As to output, the writer was a day or two ago in the works of a firm situated within an hour's railway journey of Londo and employing rather less than 1,000 workpeople in machine shops and foundry. The hourly output here was reported only 60 per cent of that previously obtained.

More Resolutions Against the Metric System

By the National Association of Machine Tool Builders

The experience of Germany, in which the old measures are still in large use, has shown that the change cannot be completed even after a generation of confusion.

The sale of many million dollars' worth of machine tools has been made abroad, by members of this Association, especially to France and Germany, without requirement or request by the purchasers for changes in general construction to conform to metric measurements, the only changes being in adjusting and measuring screws, the great majority of machines needing no changes whatever.

The adoption of the metric system would entail an enormous first cost of new equipment to conform to the new standards and a constant increased cost in the maintenance of a double standard for repairs and renewals, and a consequent increased cost of the product to the consumer.

By the National Metal Trades Association

WHEREAS, The renewed agitation for the adoption of the metric system has reached the danger point and called into being the American Institute of Weights and Measures to combat it; and

WHEREAS, The National Metal Trades Association is in full sympathy with the object of the Amer- Institute of Weights and Measures;

RESOLVED, That the Association make application for Association Membership in the Institute;

RESOLVED, That we urge all our members to lend their co-operation to this work by joining the Institute as Corporation Members.

What Is a Machine Tool?

By L. L. Thwing

Someone has recently asked for volunteers to make up a definite list of all tools or machines that can properly be included under the general heading of machine tools. Such a list would be rather long, and in its place I would like to offer a definition that includes all machines that are entitled to be included in such a list.

A machine tool is any metal working machine whose waste is in the form of chips. This is not a descriptive definition, but it has at least the virtues of being both definite and brief. There is little dispute about what a machine is, and none about chips. We know that grinding wheel sparks are chips, and that press and shear waste is not.

It is evident that this definition excludes sheet-metal machinery, and various other machines that are often included in the machine-tool class, but I will not attempt to answer any objections until they take definite form.

SPARKS FROM THE WOR

Valentine Francis

Low Production State of Mind, Says J. H. McGraw

Outlines Position of the Business Press As a Force in Increasing Production

"Low production is an accepted axiom in industry throughout the world today, and to bring about increased production it is necessary to change the state of mind as well as the physical element," declared James H. McGraw, president of the McGraw-Hill Publishing Co., at the general session of the United States Chamber of Commerce in convention at Atlantic City, N. J., last week. He said:

"No greater force for practical accomplishment exists at hand than the business press of America. This huge fabric of industry is threaded by more than 2,400 business papers, trade papers, engineering papers, technical journals and industrial papers.

"The one great problem of how to increase production, which is facing the world today, divides itself into several major problems. If the business men of America will intelligently consider these major problems, if they will recognize the slow, but sure, process of education in the solution of these problems, the business press stands ready as one all-embracing medium through which the vital and intimate needs of the separate trades or professions may be consistently and comprehensively developed.

"If we may emphasize, as we can emphasize, through the business press that the majority of the industrial leaders of America were once workmen, that 11 out of the 24 railway presidents, for example, today, were once messenger boys or clerks, that dozens of managers and superintendents, and hundreds of capitalists and financial men were one time store clerks or farmer boys or mill men, we will have at least gone part way toward the solution of the so-called labor problem.

"There is a business paper for practically every trade and profession in the country. The editors of these papers are alive to the fact that workmen of today are managers of tomorrow, and have an opportunity for leading the thinking of their industries in no uncertain way. America is still a land of opportunity in industry, and hundreds of business papers today are pointing out individual opportunities for men, making them better merchants, better engineers, literally acting as text books for the teaching of common-sense economics in industry.

"The business press is pointing out the practical plans that have been and are being worked out in individual plants for bringing men and management together. We can make rules and we can agree on fundamentals with regard to the relations between men and men, but no plan will succeed and no rule will work unless the white-collared workers in the office, who are responsible for carrying it out, have an actual working contact either themselves, or through others in sympathy with their ideas, with the overall-clad workmen in the factories.

"I have said that increased production and the possibilities of increased production is a state of mind. No body of men is more responsible for this state of mind than the management. There is just as much opportunity for the development of the intelligent application of management to industry as for the intelligent application of machinery to the processing materials. The business press sees men and machinery and material and capital put together, and made a co-ordinate working whole by management.

"We will never have production until we have maximum skill in labor, minimum use of materials, and maximum skill in management. Here again our nation has led the world in certain kinds of thinking. Periodically we have had waves of efficiency cross our fields of industry. Our drive for more efficient operation brings the ideal conditions that much nearer, and here again the technical press has had and will always have an educational function in the forwarding of such movement.

"In all this work the business press has a double relation. It is evident from what has been said that one of its values is based on the vitality of its editorial relation to the industry which it serves. It must draw and in worthwhile business does draw, its editors from the industry. They may be and are men of knowledge of their particular lines.

"But of more importance possibly than the relation of the business press as a recorder and a clearing house of ideas is its professional relation to its industry or trade. The editors of the business press have the opportunity to be both a part of an industry and to stand on the side lines looking out over industry. They can see, because of their exceptional opportunities for investigation and association with leaders of their particular fields, the general trend of an industry. They can help and do help point out and chart the way of the industry, and they have a sense of responsibility toward the public which that particular industry may serve, which is one of the fundamental values of the business paper."

Machinery Sales Association Organized

A syndicate of seven large machinery manufacturing concerns has been formed under the name of the Machinery Sales Association. The combination takes over the duties of a sales agency for the various products of its members, each firm acting as an advertising and selling agency for the other six.

To date the members of the association include: The Day Machinery Co., of Buffalo, N. Y.; W. J. Baird Machinery Co., Detroit, Mich.; Scott, Banshach Machinery Co., Chicago, Ill.; Cleveland-Duplex Machinery Co., Cleveland, Ohio; Siefreat-Woodruff Co., Cincinnati and Dayton, Ohio; McCoy-Brandt Machinery Co., Pittsburgh, Pa.; and the Eastern Machinery and Equipment Co., Philadelphia, Pa.

G. J. Hawkey, of the Cleveland-Duplex Co. is secretary of the association.

Peru Ratifies Pan-American Trade-Mark Convention

A cable from the American legation at Lima, Peru, announces the ratification by the Peruvian Congress of the International Trade-Mark Convention on April 14, 1920. Including Peru, six South American countries have ratified the convention and only the ratification by one additional country is necessary to complete the number required for the establishment of the registration bureau at Rio de Janeiro, which is to have charge of the registrations for the southern group. According to a recent announcement by the Director of the International Bureau for the Registration of Trade Marks at Habana, the privileges of international registration through the Habana bureau have been extended to the ratifying countries of the southern group of States, pending the establishment of the second bureau at Rio de Janeiro.

Frevert Machinery Co. Acquired by Peter A. Frasse & Co., Inc.

The announcement has been made that Peter A. Frasse & Co., Inc., New York, has purchased the stock of machinery and merchandise, and the good-will of the Frevert Machinery Co., of 38 Vesey St., New York. All of the employees of the latter company will continue with Peter A. Frasse & Co., Inc.

The Frevert Machinery Co. has been in business since 1906 and is well known to the trade as a dealer in a general line of metal-working tools and machines of every description. It has acted as agent for many prominent manufacturing concerns, among which might be mentioned the R. A. Kelly Co., Ohio, crank shapers; Reading Chain and Block Corp., Reading, Pa., multiple gear chain hoists; W. Robertson Machinery and Foundry Co., Buffalo, Economy hacksaws; F. J. Lindgren & Co., Rockford, Ill., drills; Richert & Shaffer Co., Erie, Pa., tapping machines; Builders Iron Foundry, Providence, grinding and buffing machinery; Woods' Turret Machine Co., Brazil, Ind., turret machines; Albany Hardware and Specialty Manufacturing Co., Albany, Wis., 12 in. high-speed drills; Diamond Machine Co., Providence, emery grinding and polishing machinery; Walcott Lathe Co., Jackson, Mich., lathes, shapers and rack cutters.

F. T. Tucker and H. B. Slate of the sales force of the Frevert Machinery Co. will continue with Peter A. Frasse & Co. They have a wide experience in the machinery line, and are well known to the trade in the territory covered by New York State and parts of New Jersey, Connecticut, Rhode Island and Delaware.

From Elevators to Machine Tools

Announcement has been made that the Standard Plunger Elevator Co., of Jamesville, Mass., will discontinue the manufacture of complete elevators and will devote its entire efforts to the production of machine tools. The company will specialize in the building of metal planers.

Governing Boards of Founder Societies Meet in Chicago

Consider Plan to Amalgamate All Engineering Societies to Promote Teamwork Among Engineers

At the suggestion of the Western Society of Engineers the governing boards of the four founder societies met in Chicago on April 19 and 20, to consider a plan for uniting all Chicago engineers into one society for combined action in technical and professional advancement and public affairs. The meeting was also planned to give an opportunity for a discussion of the inter-relations of the Western Society of Engineers and the Chicago chapters of the founder societies as well as the general plans for service. The opportunity for a general interchange of ideas between the various representative bodies came at a luncheon on Tuesday. The problems confronting each society were taken up at individual meetings of the respective councils throughout the two days.

On Monday evening there was a dinner of the joint engineering societies, at which A. Stuart Baldwin, past president of the Western Society of Engineers, officiated as toastmaster. In his opening remarks, Mr. Baldwin referred to the four founder societies as the foundation on which all other engineering associations had been formed, and to their early tendency toward separation and division, each new society specializing in its own particular field. Recently the pendulum has swung in the opposite direction, and engineers of the present day are drawing more closely together. They realize that in union there is strength and that maximum service can result only through unison of effort and co-operation.

The toastmaster called in turn upon Arthur P. Davis, president of the American Society of Civil Engineers; Arthur Fletcher, representing the American Institute of Mining and Metallurgical Engineers; Fred J. Miller, president of the American Society of Mechanical Engineers, and Calvert Townley, president of the American Institute of Electrical Engineers. Each spoke of the change in the last five years which has brought the recognition that to keep abreast of the times all societies must broaden their fields and functions and that they should always stand ready to adopt new ideas.

It was conceded that there was need for more teamwork among engineers, and in order to do effective work for the city, the state and the nation they should combine. There should be publicity to enlighten the public about engineers and their work so that confidence might be placed in their judgment. In rendering service to the public it was the thought that views expressed should be on the technical side of the question. In other words, the engineer should in a sense be an expert witness, not a politician.

By joint activity there was expectation of dealing more effectively than ever before with public matters.

There are one hundred thousand engineers in the country separated into many organizations, each doing something in its own way. If they could be made to understand that no attempt was being made to interfere with their work, and that they were requested to participate only in questions of public interest, they should be willing to co-operate and it was the consensus of opinion that they would.

As the closing event in a most enjoyable evening, enlivened by community singing and an orchestra, Dr. Theodore G. Soares, of the faculty of the University of Chicago, delivered an address on "Efficient Democracy." He impressed the audience with the need of co-operation and more able direction in the great undertakings of the day—that the problem is not to find big things to do, but to find enough big men to do the work waiting for them. Also the need for expert advice in questions of finance, education, engineering and for a more intelligent democracy to choose its experts.

A. L. De Leeuw With Illinois Tool Works

A. L. De Leeuw has associated himself in an advisory capacity with the Illinois Tool Works of Chicago, and will be located at the New York branch, 127 Water Street. Mr. De Leeuw has an international reputation built up by years of study and practical experience.

Cutter and milling problems will be handled by Mr. De Leeuw in the Eastern district.

A complete stock of high-speed-steel tools will also be carried by the Illinois Tool Works in its new and greatly enlarged quarters.

LD'S INDUSTRIAL FORGE
News Editor

A. S. M. E. Program for Its Annual Meeting

Headquarters in Hotel Statler, St. Louis —Some of the Papers to Be Read, and Subjects for Discussion

The program for the 1920 meeting of the American Society of Mechanical Engineers has just been announced. The meeting will be held at St. Louis, Mo., May 24 to 27, with headquarters at the Hotel Statler. Subjects for discussion comprise Aëronautics, with important data from the Air Service at McCook Field, Dayton, Ohio, and from the Bureau of Standards; Appraisal and Valuation; Industrial Housing; River Transportation, a subject of pressing importance in the Mississippi Valley; Foundry Practice, dealing with cast iron, steel castings, malleable castings, die castings, alloys, etc.; Power and Combustion, including stokers, pulverized fuel, feedwater heaters, and feedwater treatment; and miscellaneous topics, among which are Screw Threads, Weirs, Flow of Air and Gases, Heat Transmission, etc.

Two papers have come from Government sources, one by Lieut. E. R. Jackson, Tank Trailer and Tractor Division, U. S. A., on The First Transcontinental Motor Convoy; and the other by Lieut.-Col. H. W. Miller, Artillery Division, U. S. A., on The German Defenses on the Coast of Belgium. These timely and interesting papers will be illustrated by slides and moving pictures.

A large excursion is planned, en route to St. Louis, to the wonderful plant of the Mississippi River Power Co., at Keokuk; and following the meeting there is to be a trip to the oil fields at Tulsa, Okla.

At St. Louis an entertainment program of extreme interest has been arranged by the Local Committee, with a banquet, an entertainment at the open air municipal theatre and visits to many points of interest.

Blast Furnace at Newcastle

A new and up-to-date blast furnace is being erected at Natal, Newcastle, Australia. This furnace will include all modern appliances. It is at first intended to manufacture cast-iron pipes and the management is in negotiation for machines working on the centrifugal principle. Another line will be heavy iron and steel castings, using a side-blow converter for making steel, to be followed later by open-hearth furnaces and a heavy 28-in., three-high rolling mill.

Secretary of Navy Authorizes Sale of 30,000 Tons of Steel

The Secretary of the Navy, in view of the continuation of the shortage of manufacturers' steel, has authorized the sale of an additional 30,000 tons of steel held by the Navy. This is the second quantity of steel which the Navy has put on sale recently, the first sale being held about six weeks ago. There are included in this sale most of the merchantable types of steel, including plates, sheets, rods, billets, angles, channels and I-beams. Bids will be received up to May 5, 1920, at Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for this steel.

A catalog may be obtained upon request showing the size, physical and chemical characteristics of every piece of steel offered. Purchasers may select the exact pieces which they may require and all offers will be considered either for small or large quantities.

The Shaw-Walker Co., of Muskegon, Mich., is building a new addition and will buy additional press equipment later.

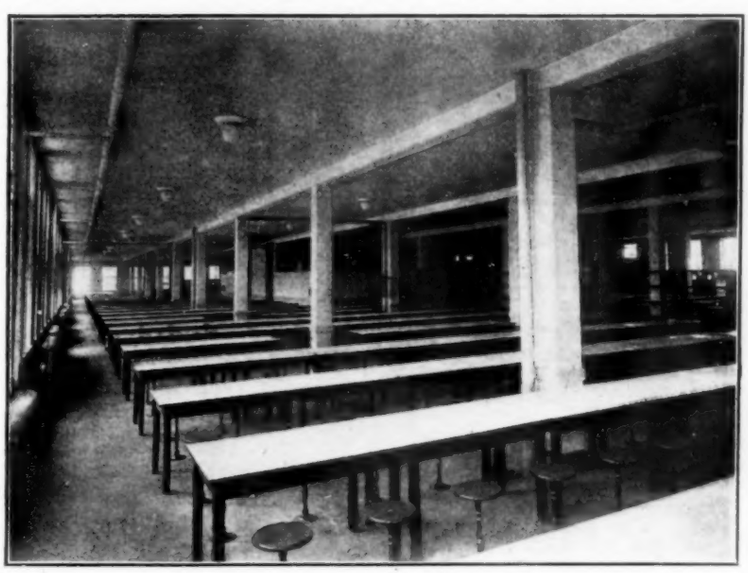
Westinghouse Opens Largest Employees' Cafeteria

On April 6, when the largest industrial eating place in the world was officially opened by the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., evidence was given of what the larger manufacturers of today are doing in the way of providing for the comforts of their employees. This new cafeteria, which is a three-story reinforced-concrete and brick building, 236 x 100 ft., has a seating capacity on the first two floors alone of nearly 2,600 persons. In addition, on the third floor is a dining room with a capacity of 500 and an auditorium with a seating capacity of 1,000.

One of the main features is the fact that there are no steps in the main part of the building. Gradual inclines or ramps are used exclusively in order to facilitate moving the diners from floor to floor.

The first and second floors are devoted to cafeteria service, a section being reserved for women employees of the company.

The cafeteria is equipped with the most modern labor-saving conveniences that are obtainable. On the first and second floors are eight service counters, sixteen coffee urns, milk freezers with a capacity of 40 gal. each, and sanitary drinking fountains.



THE WESTINGHOUSE CAFETERIA

Soiled dishes are carried from the first and third floors to the second floor where two large motor-driven dish washers are installed, which wash and dry the dishes.

A portion of the first floor adjacent to the cafeteria is fitted up with a motor-driven washing-machine mangles, steam dryer for the purpose of washing and drying linens, motor-driven ice-cream freezer with a capacity of 10 gal. and an ice-making machine with a capacity of 2,000 lb. every 12 hr. The ice manufactured is to be used for the purpose of packing ice cream, cooling butter, making iced tea, lemonade, etc. There is also an ice-cream storage artificially cooled.

All food will be cooked on the third floor and will be supplied to the cafeterias by subconveyors. The kitchen is equipped with every possible method of convenience, including large gas ranges as well as double unit combination gas and coal ranges, steam meat roaster, steam service table, potato peeler which peels 40 lb. of potatoes in less than 2 min., bread cutter, potato masher, and a coffee urn for dining-room service. Two steam-heated kettles with a capacity of 60 gal. each are used to make soup. There is also an electrically heated pie baker with a capacity of 65 pies in 15 to 20 min., one large refrigerator for cooling meats and two smaller ones to cool vegetables and dairy products. All the refrigerators throughout the plant are cooled by brine pipes.

By means of the auditorium on the third floor a suitable meeting place for the various employee organizations is provided.

F. F. Beall Heads Gray Motor Corporation

Formerly Vice President of the Packard Motor Car Co.—New Concern Capitalized at $4,000,000

F. F. Beall has accepted the presidency of the Gray Motor Corporation, a newly formed $4,000,000 automobile concern. Mr. Beall for the last seven years has been vice-president in charge of manufacturing of the Packard Motor Car Co. Associated with Mr. Beall are a number of prominent Detroit automobile men, including William H. Blackburn, formerly production manager of the Cadillac Motor Car Co., who is factory manager of the new Gray Corporation. The company's securities have been underwritten.

The Gray Motor Corporation capitalization consists of 400,000 shares of class A stock, par value $10, and 400,000 shares of class B stock of no par value. Later a syndicate offering will be made. The plant, equipment and business of the Gray Motor Co. of Detroit, builders of the Victory motor, have been acquired and the body will be designed by Briscoe and Storey, under plans originated by the Benjamin Briscoe and Stahl Engineering Co. It is stated that the new company starts business with an assurance of capacity orders, for beside the domestic demand arrangements have already been perfected for the sale of the Gray car in Europe and other foreign countries. It is planned to produce 30,000 cars annually upon which production the management estimates net earnings of over $3,000,000 after full allowance for taxes and depreciation.

Expansions in the Link-Belt Co.

The increasing amount of business in its line has made it necessary for the Link-Belt Co., Chicago, Ill., to plan a very extensive program for expansion of its various manufacturing plants. At the Indianapolis chain works two new furnaces have been added in the last few months, making a total of eight. The Link-Belt Co. has also recently purchased the Fairmount Foundry at Philadelphia, which will be used an an adjunct to the Eastern works, supplying it with gray-iron castings. New office buildings are planned or under construction at both the Philadelphia and Chicago works, and at the foundry of the latter works, a new conveying system is being installed to speed up the output.

Machinery Club of Chicago Votes

The fourth annual election to fill vacancies on the board of governors of the Machinery Club of Chicago was held on April 20, 1920. The following members were elected to serve for a term of three years: Charles J. Becker, E. L. Essley, J. R. Porter and A. G. Bush.

After having been torn up for several months while extensive alterations were being made in the club rooms, the club is now fully settled and enjoying the additional space which was secured on the same floor of the building they had been occupying. The dining room and kitchen were both enlarged and the billard room has received the addition of two new billiard tables. The old lounging room has been changed from the east to the northwest corner of the building, the space it formerly occupied having been added to the dining-room. More room was secured for the lounging room in the additional space which was secured by the club. The club has now a membership of well over 1,000.

Spang & Co., of Butler, Pa., is building a new forge shop.

Trade Letters from New York and Chicago

NEW YORK LETTER

April 30, 1920.

There has been no noteworthy development in the machine-tool market during the past week. While inquiries were not as numerous as during the previous two weeks, there was a steady volume of business reported for all lines.

The largest list was submitted by the Roanoke, Va., office of the Norfolk & Western R.R. Co. Proposals were asked for on cutters, boring machines, lathes, grinding and drilling machines. Short lists were sent out by the Boston Elevated Co., and the Chesapeake & Ohio R.R. Co.

Although the embargo on freight caused by the railroad strike has been lifted on the New York Central lines, shipments are slow and uncertain, and conditions on the other roads affected by the strike are still chaotic. The expressage embargo also is hindering machine-tool shipments.

Deliveries in the many lines cannot be promised inside of three or four months. This fact together with the uncertainty of the raw-material market, prevents many manufacturers from installing new presses and other equipment to take care of present rush orders. There is a growing tendency reported on the part of machinery manufacturers to withhold enlarging their plants until stable conditions are guaranteed for the future in both the labor and raw-material markets.

CHICAGO LETTER

With the "outlaw" rail strike still in effect, though with constantly diminishing force, dealers have been working under a severe handicap the past few days. Conditions have been mitigated to such an extent that shipments into and out of Chicago are proceeding with fair regularity but shipments from any point through Chicago are still under embargo. The effect is that dealers are enabled to replenish stocks and to ship therefrom, but direct-shipment business is badly interfered with. No complaint is heard in the trade and the let-up in purchase orders has not been nearly so severe as might have been expected.

Orders and inquiries continue to come in with demand spread over a wide range of equipment and originating in an equally wide variety of industries. So diversified is the buying that it is hardly possible to point out any particularly notable feature. It is very probable that when April totals are struck it will be found that new business booked equals or exceeds the amount of goods shipped. Thus the gross amount of goods on back order remains about constant.

Credit conditions, for the first time in many months, appear tight. This arises from three factors; the inability of manufacturers to make shipment on completion of goods, thereby increasing the volume of capital tied up in finished stock inventory; the greatly increased time consumed in transit, thereby proportionately increasing the length of time money is outstanding on transactions; and the general reluctance of banks to extend or renew credits. This should cause care in the granting of credits by machinery dealers in the near future and should accentuate the existing healthy condition of the trade.

The Krasberg Engineering and Manufacturing Co. announces that they are to discontinue their tool and die making and their special contract department, devoting their entire energies to the manufacture of phonograph motors. The rearrangement of their plant will give them a capacity of 3,000 motors a day. The Pullman Co. also has contracted to devote a great portion of its capacity to turning out talking machine cabinets.

Business with dealers in supplies continues excellent. The removal last week of the long standing embargo on express shipments has removed a serious annoyance.

Short News Notes

The equipment inquiries recently made for the Chilean state roads will exceed in value $8,000,000.

The Lacey Manufacturing Co., of Bridgeport, Conn., has been organized with a capital of $25,000. The company will manufacture machine tools and small parts of machinery. Franklin G. Hubbard, is president, and F. E. Lacey is secretary and treasurer. Mr. Lacey was formerly connected with the Bridgeport Gun and Tool Co. Mr. Hubbard is of the firm of Hubbard & Harris, of Bridgeport. The new company will begin operations shortly.

Engineers to Meet at St. Louis

The tentative plans for the fifth annual convention of the American Association of Engineers have been announced here. The Planters' Hotel, St. Louis, will be the gathering place and the dates have been made public as May 10 and 11. According to the programme as announced, the following subjects will be among those discussed by the engineers: Shall a special charge for special service be made by the employment department? A permanent home for A. A. E. What part shall A. A. E. take in the Presidential campaign? Americanization and man power engineering. The Federal department of A. A. E. at Washington. Opportunities for the engineer in civil, structural, mechanical, mining and chemical fields. Unity of the engineering profession in the United States.

WHAT "DR." W. T. CLUB WOULD MAKE 'EM DO.

House Wife: Syrup, 90 cents a gallon? Let me see: a liter is 0.2642 gal. Well, bring me a liter of it, and bring change for a $20 bill.

General Electric Co. Has Machinery Sent to Bartlett-Hayward Plant

Local machine-tool manufacturers who had contracted to furnish machines to the General Electric Co. for its Bridgeport, Conn., plant, which was formerly the U.M.C. factory, were notified this week to divert the equipment ordered to Baltimore, Md. The General Electric Co. has taken over the Bartlett-Hayward plant—which was used to make ammunition during the war. By adding some machines to the tools already at the factory the plant will be fully equipped and ready for operation within a short time.

Charles W. Johnson

Charles W. Johnson, assistant director of engineering for the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., died from double pneumonia on April 21, 1920, following an illness of only a few days.

Mr. Johnson was born June 30, 1874, and was graduated from the Ohio State University in 1896. He then entered the employ of the Steel Motor Co., Johnstown, Pa. Later he became superintendent of the Allis-Chalmers Bullock Co. of Cincinnati, Ohio. He entered the employ of the Westinghouse Electric and Manufacturing Co. in 1907 and was soon appointed chief inspector. In 1912 he became general superintendent of the East Pittsburgh Works, and in the early part of 1919 was made assistant manager of works. On Jan. 1, 1920, he was appointed assistant director of engineering.

Mr. Johnson was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Engineering Society of Western Pennsylvania.

Personals

Arthur Kirkland, formerly sales engineer with the Detroit Tool Co., is now manager of the Cleveland office of Russell, Holbrook & Henderson, Inc., of New York. This office has been established for the purpose of handling the sales of the Sanford precision centerless cylindrical grinding machine. It is located at 548 Leader News Building.

Leslie B. Stevens has been promoted to office manager at the Elmwood plant, of the New Departure Manufacturing Co., of Bristol, Conn. Mr. Stevens is a graduate of Dartmouth College, class of 1917; he has since been with the New Departure company.

C. A. Severin has been appointed manager of the Cleveland branch of the Becker Milling Machine Co., located at 408 Frankfort St., Cleveland, Ohio, handling its full line of milling machines and milling cutters. Mr. Severin will be assisted by Charles Brandhill who has been in the employ of the Becker Co. for a number of years.

Paul C. Baldwin, formerly office manager at Plant "C," of the New Departure Manufacturing Co., of Bristol, Conn., has been appointed office manager in Plant "D" of the company, which is in Meriden, Conn. Plant "C" is in Elmwood, a suburb of Hartford, Conn.

Charles E. Hildreth, president of the Worcester Chamber of Commerce, made his first visit to the general office yesterday in several weeks, having been confined to his home with pneumonia. He was able to resume business and last week went to Atlantic City, N. J., with other delegates, to represent the chamber at the annual meeting of Chamber of Commerce of the United States.

Charles D. Ingram, of Sacketts Harbor, N. Y., has become associated with the mutual interest department of the Aluminum Co. of America, Massena, N. Y.

Lyle B. Marcy, formerly superintendent of the Hart & Cooley Co., Inc., New Britain, Conn., has become connected with the Chase Companies, Inc., Waterbury, Conn., in the capacity of research engineer.

Leon B. Stoddard, formerly with the Pratt & Whitney Co., of Hartford, Conn., is now superintendent of the toolroom of the Gilbert & Barker Manufacturing Co., of Springfield, Mass. Mr. Stoddard has assumed his new duties.

F. L. Rowland has been made second assistant treasurer of the Gilbert & Barker Manufacturing Co., of Springfield, Mass., at a recent meeting of the company directors. Mr. Rowland has been with the company since November, 1918, during which time he was office manager.

A. C. Johnston, formerly chief engineer of the Chicago Works, has been elected a vice president of the Link Belt Co., and resident general manager of the Chicago plant. He succeeds Prentiss L. Coonley, who has resigned in order to devote his time to the presidency of the Isko Manufacturing Co.

Frank Heffernan, of the New Departure Manufacturing Co., Bristol, Conn., has been appointed to have charge of the Sub-Die work in the new plant D of the company at Meriden, Conn. Mr. Heffernan has been with the company over seventeen years, and is now with the Sub-Die department of plant A, in Bristol.

Edward Keeling, for many years connected with the Traut & Hine factory, New Britain, Conn., as foreman of the tool department, left the employ of the company recently.

Robert M. Roof, mechanical engineer for the Laurel Motors Corporation, has returned from business visits to Detroit and Indianapolis where he purchased several thousands of dollars worth of new machinery for the new motor building addition which is to be built to the Laurel plant on Sycamore Street.

Evald Anderson, assistant superintendent of the gage room in plant A of the New Departure Manufacturing Co., in Bristol, Conn., has been selected to have charge of the gage department in the new plant D of the company, now nearing completion in Meriden, Conn. Previous to being with the New Departure, Mr. Anderson was with the Corbin Screw Corp., of New Britain, Conn.

Harry G. Stoddard, official of the Wyman & Gordon Co., drop-forgers, of Worcester, Mass., has been elected to the board of directors of the Boston & Maine Railroad Co. at a meeting held in Boston, April 14.

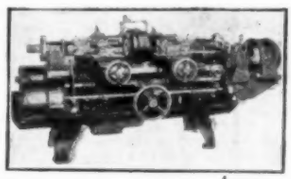
Condensed-Clipping Index of Equipment

Patented Aug. 20, 1918

Dividing Head, Universal.
Simmons Machine Co., Inc., Albany, N. Y.
"American Machinist," April 15, 1920

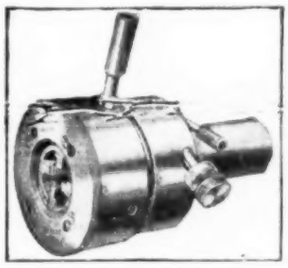
The new model is equipped with a spiral attachment and has a 10-in. swing. Spindle has a No. 10 B. & S. taper hole, is provided with adjustment for wear, and can be firmly locked during the cutting operation. Head is graduated and can be adjusted to any angle from 10 deg. below horizontal to 10 deg. beyond perpendicular, and is provided with substantial clamping means. Equipment includes three index plates, four ⅜-in. bolts, and a malleable iron driving dog.

Lathe, Double-End, Center Drive.
Greenlee Bros. Co., Rockford, Ill.
"American Machinist," April 15, 1920



Was originally designed for turning both ends of an automobile axle at the same time. It is now being applied with equal success to bar and shaft work requiring turning only on the ends. Specifications: Two sizes, 36 in. and 60 in.; maximum diameter to be turned, 2⅞ in.; hole through center of drive head, 3½ in.; floor space, 36-in. machine, 44 in. x 10 ft., 60-in. machine, 44 in. x 12 ft.; height overall, 64 in.; motor required, 5 hp., 1,200 r.p.m., constant speed; belt drive, 16 x 5½ in. pulley, 5-in. belt; weight, 36 in. machine, 4,950 lb., 60-in., 5,400 lb.

Die Head, Coventry Self Opening.
Alfred Herbert, Ltd., 54 Dey St., New York City, N. Y.
"American Machinist," April 15, 1920

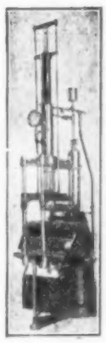


The dies are made of high-speed steel. The form of the die is such that a keen cutting edge is obtained at the front, with a non-cutting guiding portion farther back, acting like a guide nut. Large diameters can be threaded without over-stressing the material. The straight-cut dies can all be ground at the same operation, as a grinding fixture is provided for that purpose. The die head will cut right or left hand threads and can be used on screw machines. Made in seven sizes with capacities ranging from ⅛ to 3 in. diameters. Dies may be adjusted to cut above and below the standard size.

Lathe, Conradson Geared Head Engine.
Jos. T. Ryerson & Son, Chicago, Ill.
"American Machinist," April 15, 1920

This machine is made in five different sizes, 15-, 18-, 22-, 27- and 33-in. swing and with lengths of beds to suit. Specifications: Size, 22 in. x 10 ft.; swing over bed, 25½ in.; over carriage, 20½ in.; distance between centers, 5 ft. 1 in.; front spindle bearing, 5¼ x 8 in.; hole through spindle, 3⅛ in.; taper of spindle (center held in collet), No. 14 Jarno; diameter of threaded nose, 4¾ in.; number of spindle speeds, 12; range of spindle speeds, 10 to 222 r.p.m.; number of feed changes, 28; range of threads cut on standard lathe, 2 to 28; diameter of tail stock spindle, 2⅞ in.; speed of main drive shaft, 900 r.p.m.; horsepower required, 5; floor space, 153 x 51¼ in.; extreme height, 53⅝ in.; net weight, 7,000 lb.

Press, Tappet Guide-Hole Broaching.
Metalwood Manufacturing Co., Detroit, Mich.
"American Machinist," April 15, 1920



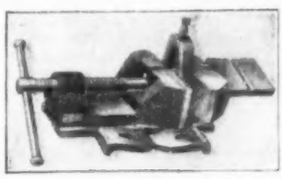
A press designed for finishing motor tappet guide holes. The method of sizing is economical and produces an accurately finished hole. The press is of the pneumatic-hydraulic type in which the only power furnished from an outside source is compressed air. The air acts through an intensifying chamber to force a flow of the fluid to the hydraulic chamber where it operates the ram.

Grinding Machine, Economy Floor.
Marschke Manufacturing Co., Indianapolis, Ind.
"American Machinist," April 15, 1920

The starting mechanism for the motor is placed inside the column and is controlled by a treadle in front of the base. This treadle can be locked in running position. A feature of the design is the ease with which the motor armature may be removed if necessary.

Specifications: Wheel, 12 in. dia., 2 in. face; motor, a.c., 3 hp., d.c., 2 hp.; length of arbor, 26 in., diameter of arbor, a.c., 1¼ in., d.c. 1 in.; center of arbor to floor, 39 in.; size of base on floor, 20 x 23 in.; weight a.c. type 575 lb., d.c. type, 650 lb.

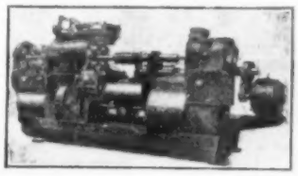
Vise, G. S. Combination Machine.
Germanow-Simon Machine Works, Rochester, N. Y.
"American Machinist," April 15, 1920



The base is a solid casting with two ⅝-in. slots planed in the bottom. The jaws extend at both sides and are faced with removable case-hardened steel plates; the slidable jaw is provided with vertical and horizontal V-grooves for holding the work. The other jaw is arranged to swivel and is held by a single nut. The V-groove across the top of the jaws takes clamps. The vise is made in two sizes and the clamp shown, takes the place of V-blocks, bolts and clamps.

Specifications: Sizes Nos. 1 and 2. Opening of jaws, 5 in., 7 in.; height of jaws, 2½ in., 3 in.; width of jaws, 8 in., 9½ in.; width of bases, 6½ in., 7½ in.; capacity of clamps, 2 in., 3½ in.; net weights, 75 lb., 106 lb.

Screw Machine, Multiple Spindle.
National Acme Co., Cleveland, Ohio.
"American Machinist," April 15, 1920



Machine is made in two sizes, 3 in. and 4 in., with belt or motor drive. A 10-hp. motor is required for the 3-in. machine, and 15-hp. motor for the 4-in. machine. High-speed drilling and reaming attachments furnished when required. Main tool turret is a one-piece steel casting supported on bearings that permit heavy cuts and fast feeds. Toolholders have wide bearings on flat surfaces of end-tool turret, and support tools directly below their cutting points. Forming and cut-off slide bearings are cast with bed and arranged to support full length of the tools. Slides are adjusted vertically and horizontally by taper gibs. Top slides are controlled by two interchangealbe cams.

Clip, paste on 3 x 5-in. cards and file as desired

Business Items

The steel department of the C. Pardee Works, which has operated an openhearth steel plant consisting of four furnaces, a 34-in. blooming mill, two bar mills and a turned, polished and cold-drawn shafting plant at Perth Amboy, N. J., has been taken over by a new corporation, the Pardee Steel Corporation, recently incorporated in the State of Delaware. The new company will continue along the same lines as the C. Pardee Works and will be under the management of George Graham Bell. The officers of the new company are: President, Clarence M. Brown; vice-president, George Graham Bell; secretary, K. C. Acton; treasurer, J. Newlin Brown.

The Hall Planetary Thread-Milling Machine Co. of Philadelphia, Pa., a corporation recently organized, has arranged to take over the machinery and equipment of the Hall Gas Engine Co. and the material on hand useful for thread-milling machines.

The Morse Chain Co., Ithaca, N. Y., has moved its offices from Greensboro, N. C. to Charlotte, N. C.

The Monarch Machine Tool Co., Sidney, Ohio, has just gotten out a catalog describing its lathes in Italian, French and Spanish.

The Combustion Engineering Corporation, New York City, manufacturer of mechanical stokers, grates and other boiler-room equipment relating to combustion engineering, announces with considerable regret the resignation of its vice president, in charge of sales, E. P. Moritz. Mr. Moritz had been ill for some time previous to his resignation and owing to his continued ill health it has been necessary for him to retire from active business for some time. No successor to Mr. Moritz has been named by the company up to date.

The McMullen Machinery Co., Grand Rapids, Mich., has formed a handling and conveying equipment department and will specialize in electric and pneumatic cranes and hoists, etc. K. K. Hicks, engineer, will be in charge.

The Imperial Brass Manufacturing Co., 1200 West Harrison St., Chicago, Ill., announces that its New York office will be located after May 1 in the Longacre Building, Suite 605, 42d St. and Broadway.

The Precision Tool and Gauge Co., of Bridgeport Conn., has been purchased by the Liberty Manufacturing Co., which has established executive offices in the Meigs Building, Bridgeport. The new company will carry on the business at the old plant on Elm St. and is planning the erection of a large fireproof modern manufacturing building.

The Cashman Tool Co., Waynesboro, Pa., manufacturer of reamers and tools, is planning to double the capacity of its plant. H. I. Cashman is president and general manager.

The Northern Machine Corporation, Watertown, N. Y., has been incorporated to manufacture, buy, sell and repair paper-mill machinery, waterwheels, etc.

The Smith Glar-Stop Corporation, recently granted incorporation papers, and headed by Dr. Walter C. Smith D. D. S., of Watertown, N. Y., has taken over the plant, property, business and good will of the Hodge Machine and Tool Co., also of Watertown, N. Y.

The New Departure Manufacturing Co.'s new plant in Meriden, Conn., will be under the direction of Charles Gearing, as division manager, of Plant "D," as the Meriden plant will be known. The new plant is nearing completion, and will be a modern brick and reinforced-concrete plant with every convenience that can be secured. The home office of the New Departure is in Bristol, Conn., where plants A and B are operated. Plant C is in Elmwood, Hartford, Conn., with the new plant D recently acquired in Meriden, Conn.

The plant of the Munnsville Plow Co., Inc., Munnsville, N. Y., was destroyed by fire on March 25. Only the office and records were saved. The loss is estimated to be about $110,000.

Robert K. Morton, who has just bought out an interest in the Holyoke Wire Co., Holyoke, Mass., from W. A. Prentiss of the George W. Prentiss & Co., will also be associated with John H. Brewster of New York, as vice president and treasurer of the Brewster-Morton Corporation. Mr. Brewster has for the past ten years been the American representative of the largest steel mill in Sweden, making a high-grade carbon and alloy-steel product. This corporation is in the Fagersta Bruk Co., of Fagersta, Sweden. The new corporation will take over Mr. Brewster's present contracts and materially enlarge the business.

The Stewart Manufacturing Co., of Waterloo, Ia., has increased its capital stock to $300,000. Plans have been completed to provide a new assembling plant, additions to the foundry, a storage warehouse for raw materials, finished machines and a new heating plant. New machinery will also be installed in the foundry and machine shop and an overhead carrying system for the entire plant. The company has on hand orders for approximately 600 concrete mixers. The officers of the company at present are J. H. Stewart, president; O. J. Fullerton, vice president; C. R. V. Bassarear, secretary; W. H. Stewart, treasurer.

Announcement has been made of the partnership of Samuel P. Hall, formerly of the construction division of the United States Quartermaster Corps., and Colonel Harold M. Bush, recently of the Field Artillery, and mechanical engineer. They will specialize on architecture and engineering, with particular reference to factories and other industrial plants. Offices will be opened in Columbus, Ohio, under the firm name of Hall and Bush.

The Black & Decker Manufacturing Co., Baltimore, Md., has established a branch office and service station at 169 Massachusetts Ave., Boston, Mass. D. G. Caywood, Northeastern district manager, will be in charge of this new department.

The Hanson Clutch and Machinery Co., of Tiffin, Ohio, has recently increased its capitalization and is now building a large addition to the present factory. The most modern type machine tools will be installed and the foundry capacity augmented to take care of the contemplated increase in production.

Spaulding-Moss Co., has removed its store and factory from 32 Federal St., Boston, Mass., to 42 Franklin St. The company has recently become the sole representative in the United States and Canada of the Bourquin fountain pen.

The Co-operative Machinery Co., has moved into its new store and warehouse at 117-121 St. Clair Ave., Cleveland, Ohio. The company has increased its capital stock from $25,000 to $40,000.

The Davis-Bournonville Co., Jersey City, N. J., announces the removal of its Boston sales office from 125 Pearl St., to 44 Federal St. George J. Strobel is the manager.

The Engineering Sales Co., Inc., New Orleans, La., has increased its capitalization to $250,000 and is now building steel warehouses and machine shops covering an area of 50,000 sq.ft. It will continue to specialize in engineering designs and appraisals, and new and rebuilt machinery. The officers are: Louis S. Weil, president and general manager, and Walter B. Moses, vice president and assistant general manager.

New Publications

American Civil Engineers' Handbook. By Mansfield Merriman. Editor-in-Chief and a staff of specialists. Fourth edition, flexible cover, 1,955 4 x 7 in. pages. Published by John Wiley & Sons, Inc., New York. Price $6.

Only a page-by-page comparison would reveal the exact changes in this latest edition of a book which has become a standard reference—and as the third edition had 1,580 pp. and the present or fourth edition has 1,955 pp. that task has not been attempted. Suffice it to say that two new sections—on Electric Railroads (55 pp.) by William A. Del Mar and on Irrigation and Drainage (63 pp.) by Horace W. King—have been added; that Searle's useful mathematical tables have been interleaved on colored paper; and that many revisions and additions have been made by both old and new authors in the effort to bring the book up to 1919, when the fourth edition closed.

Scattering examination shows some unevenness as to completeness of revision. In the treatment of concrete as a material, for instance, none of the recent studies into proportioning, aggregate or water content are noticed; the matter seems not to have been revised since the second or possibly the first edition. On the other hand the freight handling and port terminal section contains matter—such as the design of the 350-ton fitting-out crane at Philadelphia—which has not yet been made public, so recent in design and construction are they. Looking again at the other side of the ledger we find that although the article on Disposal of City Refuse has been expanded by a third it fills only two pages. This seems out of proportion to the space given to other subjects, besides which the information given is not strictly up-to-date. Such unevennesses and deficiencies as have been mentioned are to be expected where so many men go to make up a book of such wide field as to preclude one man knowing all the subjects covered. At the same time there is no doubt that this multiple-control, so to speak, is eminently satisfactory in producing so many sided a book, which improves with every edition.

The staff of associate editors now numbers eighteen, the two new men already mentioned having been added. There have been three other changes in associate editors, Walter L. Webb, Rudolph P. Miller and Frank P. McKibben having withdrawn and their places having been filled by Fred A. Barnes, Herbert F. Moore and Frank A. Constant. The corresponding sections are on Steam Railroads, Materials of Construction and Steel Structures.

Trade Catalogs

Machine Control. Monitor Controller Co., Baltimore, Md. Bulletin No. 100, pp. 31, 8 x 10½ in. This bulletin describes the Monitor system of machine-tool control and each page gives a halftone illustration showing a lathe equipped with its adjustable-speed reversing controller, a pattern shop with the Monitor automatic starter, etc.

Alundum Tile. Norton Co., Worcester, Mass. Catalog, pp. 15, 5 x 8 in. An illustrated and descriptive catalog of its alundum tile for stairs, ramps, floors, elevators, elevator landings, etc. Standard sizes are given of the tile.

Lathes. Cisco Machine Tool Co, Cincinnati, Ohio. Catalog, pp. 36, 8½ x 11 in. This catalog is printed on coated stock and shows different parts of the company's shop, and gives various sizes of its lathes. Speed charts and speeds of the Cisco geared-head lathes are also given.

Chassis Lubrication. Chassis Lubrication Co., Inc., 537 Canal St., New York City. This booklet shows the disadvantages of grease lubrication and also how adequate lubrication is attained. There are several line cuts and letters of opinion of prominent engineers.

Alundum Tile. Norton Co., Worcester, Mass. Booklet, pp. 18, 5 x 8 in. This company has issued a booklet giving a report of tests of alundum tile conducted at Columbia University. It also gives some data for similar purposes on other materials.

Drop Forgings. Union Switch and Signal Co., Swissvale, Pa. Bulletin No. 96, 6 x 9 in., pp. 22. This bulletin presents some information on the latest types of forgings made. There are several halftone illustrations of drop forgings, and the front cover shows a nine-cylinder rotary engine which was built for the United States Government.

Locomotives. The Baldwin Locomotive Works, Philadelphia, Pa. Catalog No. 95, pp. 42, 8¾ x 6 in. These pages are devoted to information on the Baldwin gasoline locomotive together with several half-tone illustrations showing the general construction and use of them.

Forthcoming Meetings

The Seventh National Foreign Trade Convention will be held in San Francisco, Cal., on May 12, 13, 14 and 15. Several group sessions, at which problems bearing on international trade relations, production, labor and other phases of industrial life, will be discussed by men prominent in these fields. O. K. Davis is the secretary of the National Foreign Trade Council.

The American Gear Manufacturers' Association will hold a meeting at the Hotel Statler, Detroit, Mich., on April 29, 30 and May 1.

The American Supply and Machinery Manufacturers' Association, the Southern Supply and Machinery Dealers' Association and the National Supply and Machinery Dealers' Association, will meet jointly on May 17, 18 and 19 at Atlantic City, N. J., at the Hotel Marlborough-Blenheim. F. D. Mitchell is the secretary and treasurer of the American Supply and Machinery Manufacturers' Association, with an office at 4106 Woolworth Building, New York City.

The National Association of Manufacturers will hold its annual convention in the Waldorf-Astoria, New York, on May 17, 18 and 19. A "Silver Jubilee" session will be held on the evening of May 17.

The National Machine Tool Builders' Association will hold its spring meeting on May 20 and 21, at the Hotel Traymore, Atlantic City, N. J.

The Industrial Relations Association will hold its second annual convention at Chicago, Ill., on May 21, 22 and 23.

The American Society of Mechanical Engineers will hold its spring meeting at St. Louis, Mo., May 24, 25, 26, 27, 1920, and will have its headquarters at the Hotel Statler.

The American Iron and Steel Institute will hold its spring meeting at the Hotel Commodore, New York City, May 28.

The American Drop Forge Association will hold a meeting at the Hotel Marlboro-Blenheim, Atlantic City, N. J., on June 17, 18 and 19. E. J. Frost, of the Frost Gear and Forge Co., Jackson, Mich., is president.

The American Society for Testing Materials will hold its next annual meeting during the week of June 21, 1920, at the New Monterey Hotel, Asbury Park, N. J. This society has its headquarters in the Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa. C. L. Warwick is the secretary and treasurer.

The Society of Automotive Engineers will hold its annual summer meeting at Ottawa Beach, Mich., on June 21-25 inclusive.

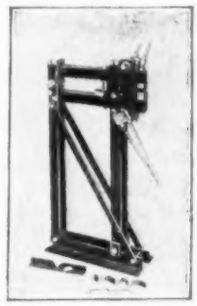
Condensed-Clipping Index of Equipment

Fatented Aug. 20, 1918

Hammer, Fairbanks Pulverizing Power
United Hammer Co., Oliver Bldg., Boston, Mass.
"American Machinist," April 15, 1920.

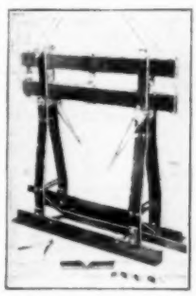
Machine is intended for laboratory use in pulverizing pig-iron samples for analytical purposes. It will pulverize ½- to ¾-in. cubes in from 2 to 3 min. so that the particles will be fine enough to pass through an 80-mesh sieve. Machine is built in one size only for belt or motor drive. Operation is by treadle, or by special starting device. Weight of ram is 100 lb. and when running at 300 strokes per min. it will strike a blow of approximately 600 lb. Size of mortar and pestle, 2 inches.

Bending Machine, Marvel No. 22 Punch, Shear and
Armstrong-Blum Manufacturing Co., Chicago, Ill.
"American Machinist," April 15, 1920.



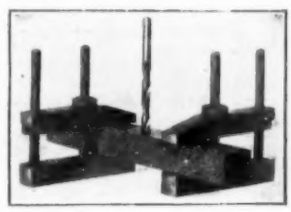
Pressure is applied by two levers to upper and lower eccentrics connected by two links. The lower parallel bars remain stationary, all the motion being in the upper bars. Specifications: Capacity, will punch ⅝-in. hole in ⅞-in. steel with 2-in. throat, or ¼-in. hole in ¼-in. steel with 6-in. throat; will shear ⅝- x 2-in. bars; vertical movement of jaw, with one lever ⅝ in.; two levers, ⅞ in.; total jaw opening, 3¼ in.; height, 48 in.; length,, 24 in.; width, 10 in.; weight, 260 lb.

Bending Machine, No. 23, Punching and
Armstrong-Blum Mfg. Co., 333 North Francisco Ave., Chicago, Ill.
"American Machinist," April 22, 1920.



Machine has eccentric and link arrangement at each end operated by hand levers. Tool-carrying bars are 4 ft. long which permits a number of punches and dies to be placed in space to punch several holes at the same time. Specifications: Capacity, will punch ⅝-in. hole in ⅝-in. steel with 2-in. throat, or ¼-in. through ¼-in. with 9-in. throat; will shear ¼ x 2-in. bars; vertical travel of tool-bar, 1/16 in. with one lever, or ⅛ in. with two levers; space between upper and lower bars, 3½ in.; height, 50 in.; length, 48 in.; width, 17 in.; weight 475 lb.

Clamps, Toolmakers Parallel
Knauel Tool Works, Rock Island, Ill.
"American Machinist," April 22, 1920.



The clamps are made in two sizes, the No. 1 with 1¼-in. opening, and No. 2 with 2¼-in. opening. A feature of these clamps is that the screws project on one side only, permitting their use in close quarters or standing in an upright position while holding the work. They are rapidly adjusted and may be tightened by the fingers or by using a pin on the rear nut.

Tap, Collapsible Pipe
Victor Tool Co., Inc., Waynesboro, Pa.
"American Machinist," April 22, 1920.

For tapping pipe threads, is provided with short straight chasers that automatically recede as they advance into the hole. As the maximum size of the taper hole is tapped first, it will be seen that the hole can not be tapped too large by running the tap too far in as would be the case with a taper tap. Taps of this type can be made in sizes from 2 to 12 in.

Parallels, Adjustable
O. B. Herlth Mfg. Co., 32 Union Place, Hartford Conn.
"American Machinist," April 22, 1920.

The parallels are hardened, ground and lapped. It is claimed that their accuracy is within 0.0001 in. and that they may be stacked in all combinations with uniform results. They may be used independently or in combination with precision blocks for such work as gaging slots, setting sine bars, buttons, snap gages, etc. Each set comprises five adjustable parallels varying from ½ to ⅞ in. minimum thickness and from 1/16 to 1⅛ in. maximum thickness.

Milling Machine, Thread
Gray Machine Tool Inc., Buffalo, N. Y.
"American Machinist," April 29, 1920.

These machines will handle bar work, regular chucking work or work held between centers. On work held in a chuck, internal threads can be cut as well as external.

Specifications of size "A" machine: Distance between centers, 18 in.; hole through spindle, 2 in.; swing over carriage, 6 in.; swing over ways, 12 in.; diameter of external threads, maximum, 7 in.; diameter of internal threads, maximum, 6 in.; spindle diameter, for multiple cutter, ¾ in.; spindle diameter, for single cutter, 1¼ in.; floor space, 36 x 54 in.; net weight, 1,600 lb.

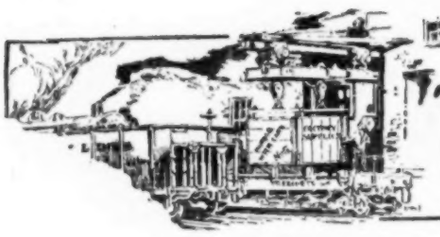
Drilling Machines, Electric Controlled
Colburn Machine Tool Co., Franklin, Pa.
"American Machinist," April 29, 1920

These machines arranged for reversing the spindle with direct-current or alternating-current motors. The a.c. equipment is contained in a metal box mounted on machine or fastened to wall.

Reversing switch is mounted on the machine and is connected to the operating lever by sprockets and chain. It has three positions: forward, neutral and reverse.

The operator when tapping a hole, throws the lever to forward position and when tap reaches desired depth, throws it to the extreme opposite position which reverses the spindle instantly and withdraws the tap. To stop the machine lever is thrown to the neutral position. The direct-current equipment differs somewhat in mechanical detail from the alternating-current equipment.

Clip, paste on 3 x 5-in. cards and file as desired



THE WEEKLY PRICE GUIDE

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$45.60	$30.35
Northern Basic	42.80	27.55
Southern Ohio No. 2	46.80	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	49.65	31.90
Southern No. 2 (Silicon 2.25 to 2.75)	49.70	33.95
BIRMINGHAM		
No. 2 Foundry	42.00	26.75
PHILADELPHIA		
Eastern Pa., No. 2x, 2.25-2.75 sil.	45.35–45.65*	30.65
Virginia No. 2	44.25*	30.85
Basic	44.50†	30.90
Grey Forge	43.50*	30.90
CHICAGO		
No. 2 Foundry local	44.25	27.25
No. 2 Foundry, Southern	47.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	45.65	28.15
Basic	44.40	27.15
Bessemer	44.90	29.35
MONTREAL		
Silicon 2.25 to 2.75%	43.25	.....

* F.o.b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York Current	New York One Month Ago	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Structural shapes	$4.47	$3.97	$3.47	$5.50	$3.37	$3.97	$3.47
Soft steel bars	4.62	4.12	3.37	5.00	3.27	3.87	3.37
Soft steel bar shapes	4.62	4.12	3.37	...	3.27	3.87	3.37
Soft steel bands	5.82	5.32	4.07	6.25	.....	.....	.....
Plates, ¼ to 1 in. thick	4.67	4.17	3.67	5.00	3.57	4.17	3.67

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Mill, Pittsburgh	$4.25	$2.35
Warehouse, New York	4.57	3.37
Warehouse, Cleveland	3.52	3.22
Warehouse, Chicago	3.75	3.37

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	New York Current	New York One Year Ago	Cleveland	Chicago
No. 10	3.55–6.00	7.12@8.00	4.57	7.30	7.02
No. 12	3.60–6.05	7.17@8.05	4.62	7.40	7.07
No. 14	3.65–6.10	7.22@8.10	4.67	7.45	7.12
No. 16	3.75–6.20	7.32@8.20	4.77	7.55	7.22
Black					
Nos. 18 and 20	4.15–6.30	8.50@9.50	5.30	7.95	7.80
Nos. 22 and 24	4.20–6.35	8.55@9.55	5.35	8.00	7.85
No. 26	4.25–6.40	8.60@9.60	5.40	8.05	7.90
No. 28	4.35–6.50	8.70@9.70	5.50	8.15	8.00
Galvanized					
No. 10	4.70–7.50	9.75@11.50	5.50	8.50	8.15
No. 12	4.80–7.60	9.85@11.60	5.55	8.60	8.20
No. 14	4.80–7.60	9.85@11.60	5.60	8.60	8.35
Nos. 18 and 20	5.10–7.90	10.10@11.85	5.90	8.90	8.65
Nos. 22 and 24	5.25–8.02	10.25@12.00	6.05	9.05	9.05
No. 26	5.40–8.20	10.40@12.15	6.20	9.20	9.20
No. 28	5.70–8.50	10.70@12.45	6.50	9.50	9.50

Acute scarcity in sheets, particularly black, galvanized and No. 16 blue enameled. **Automobile sheets are unavailable except in fugitive instances, when prices range to 10c per lb.**

COLD FINISHED STEEL—Warehouse prices are as follows:

	New York	Chicago	Cleveland
Round shafting or screw stock, per 100 lb. base	$6.25	$5.80	$6.00
Flats, square and hexagons, per 100 lb. base	6.75	6.30	6.50

DRILL ROD—Discounts from list price are as follows at the places named:

	Per Cent.
New York	55
Cleveland	50
Chicago	50

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$25.50–30.00
Cleveland	20.00	20.00
Chicago	21.00	16.50

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 12c. per lb.

WELDING MATERIAL (SWEDISH)—These prices are the best we have been able to obtain for Swedish welding materials, of which it is reported that very little are on the market.

Welding Wire		Cast-Iron Welding Rods	
1/16, 1/12, 5/64, 3/32, 7/64, 1/8, 9/64	21.00 to 30.00	3/16 by 12 in. long	14.00
No. 8, 5/32 and No. 10		1/4 by 19 in. long	12.00
3/16		5/16 by 19 in. long	10.00
No. 12		3/8 by 21 in. long	10.00
7/32, No. 14 and 1/16			
No. 18		**Special Welding Wire, Coated**	
No. 20		1/8	33.00
		5/32	30.00

Domestic—Welding wire in 100-lb. lots sells as follows, f. o. b. New York: 5/32, 8½c. per lb.; 1/8, 8c.; 5/32 to 1/4, 7½c.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.00	8.00	9.00
Spring steel (light)	8.00	11.00	12.25
Coppered bessemer rods	8.00	8.00	6.75
Hoop steel	6.07	6.50	5.32
Cold-rolled strip steel	12.50	8.25	10.75
Floor plates	6.55	6.00	6.77

PIPE—The following discounts are to jobbers for carload lots on the Pittsburgh basing card, discounts on steel pipe, applying as from January 14, 1920, and on iron pipe from January 7, 1920.

Steel Inches	Steel Black	Steel Galvanized	Iron Inches	Iron Black	Iron Galvanized
BUTT WELD					
1/8, 1/4 and 3/8	47%	20½%	1/8 to 1¼	34½%	18½%
1/2	51%	36½%			
3/4 to 3	54%	41½%			
LAP WELD					
2	47%	34½%	2	28½%	14½%
2½ to 6	50%	37½%	2½ to 6	30½%	17½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	43%	25½%	1/8 to 1/4	34½%	19½%
1/2	48%	35½%			
3/4 to 1½	52%	39½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	45%	33½%	2	29½%	16½%
2½ to 4	48%	36½%	2½ to 4	31½%	19½%
4½ to 6	47%	35½%	4½ to 6	30½%	18½%

Stock discounts in cities named are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1/8 to 3 in. steel butt welded	40%	24%	40%	31%	54%	40½%
2½ to 6 in. steel lap welded	35%	20%	42%	27%	50%	37½%

Malleable fittings, Class B and C, banded, from New York stock sell at plus 23%. Cast iron, standard sizes, net.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	Month Ago	Year Ago
Copper, electrolytic	18.50	18.50	15.25
Tin in 5-ton lots	61.00	61.50	72.50
Lead	8.87½	9.00	4.70
Spelter	8.50	8.70	6.37½
ST. LOUIS			
Lead	8.50	8.87½	4.95
Spelter	7.95	8.37½	6.02½

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York Current	New York Month Ago	New York Year Ago	Cleveland Current	Cleveland Year Ago	Chicago* April 8 Current	Chicago* April 8 Year Ago
Copper sheets, base	29.50	29.50	22.50	32.00	23.50	36.00	26.00
Copper wire (carload lots)	31.25	29.25	23.00	29.50	23.00	27.00	22.00
Brass sheets	27.50	26.50	18.75	29.00	23.00	27.00	21.50
Brass pipe	32.00	32.00	28.00	34.00	30.00	35.00	31.00
Solder (half and half) (case lots)	43.00	39.00	46.50	40.50	43.00	38.00	39.00

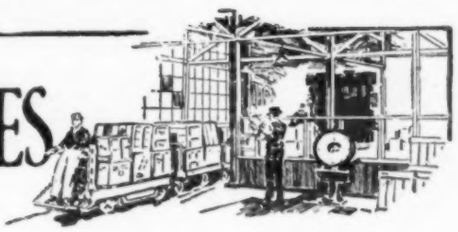
* Chicago—No stocks of brass and copper. Orders for future delivery are accepted subject to confirmation and price-fixng at 60 days before shipment — which is at manufacturer's convenience.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 2c.; polished takes 5c. per sq.ft. extra for 20-in. widths and under; over 20 in., 7½c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extra:

	Current	One Year Ago
Mill	23.75	18.00
New York	23.75	19.50
Cleveland	27.00	24.00
Chicago	26.00	24.00

SHOP MATERIALS AND SUPPLIES



ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 12.00

	—In Casks— Current	One Year Ago	— Broken Lots — Current	One Year Ago
Cleveland	15.00	14.45	15.50	14.80
New York	13.50	12.00	14.00	13.00
Chicago	15.00	16.50	15.00	16.00

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots for spot delivery, duty paid:

	Current	One Year Ago
New York	10.62½	6.62½
Chicago	11.50	7.75
Cleveland	13.00	7.75

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	— New York — Current	One Year Ago	—Cleveland— Current	One Year Ago	Chicago
Copper, heavy, and crucible	16.50@17.25	13.00	17.00	14.00	17.25
Copper, heavy, and wire	15.75@16.00	12.00	17.00	13.00	16.25
Copper, light, and bottoms	14.50@17.50	10.50	15.50	11.00	15.25
Lead, heavy	7.75@ 8.00	4.00	8.00	4.50	7.75
Lead, tea	5.75@ 6.00	3.25	5.50	3.50	6.75
Brass, heavy	9.50@10.00	8.00	13.00	9.00	17.00
Brass, light	9.00@ 9.25	6.00	10.00	6.50	10.50
No. 1 yellow brass turnings	8.75@ 9.25	7.25	10.50	7.00	10.75
Zinc	5.25@ 5.75	4.25	5.50	4.00	6.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb	33.00	34.00c.@35.00c.	33.50

COPPER BARS—From warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York (round)	33.00	25.00
Chicago	29.00	28.00
Cleveland	32.00	28.00

BABBITT METAL—Warehouse price per pound:

	—New York— Current	One Year Ago	—Cleveland— Current	One Year Ago	— Chicago — Current	One Year Ago
Best grade	90.00	87.00	74.50	79.00	70.00	75.00
Commercial	50.00	42.00	21.50	18.50	15.00	15.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	— New York — Current	One Year Ago	— Cleveland — Current	One Year Ago	— Chicago — Current	One Year Ago
Hot pressed square	+$3.00	.25	$ .75	$1.90	$.50	1.28
Hot pressed hexagon	+ 3.00	.25	.75	1.90	.50	1.08
Cold punched hexagon	+ 3.00	.25	.75	1.90	.50	1.30
Cold punched square	+ 3.00	.25	.75	1.90	.50	1.30

Semi-finished nuts, ⅞ and smaller, sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50-10%
Chicago	50%	50%
Cleveland	50%	60-10-10%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
½ by 4 in. and smaller	20%	40%	30%
Larger and longer up to 1¼ in. by 30 in.	10%	20+10%	20%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York ..... list Cleveland ..... $3.00 Chicago $3.00

For cast-iron washers, ⅜ and larger, the base price per 100 lb. is as follows:

New York ..... $5.00 Cleveland ..... $4.50 Chicago $4.25

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
½ by 6 in. and smaller	20%	35%	20%
Larger and longer up to 1 in. by 30 in.	10%	20%	15%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	One Year Ago	Burs Current	One Year Ago
Cleveland	20%	20%	10%	10%
Chicago	10%	10%	10%	10%
New York	30%	40%	30%	20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅞ and smaller	30%	40%	35-10%
Tinned	30%	40%	35-10%

Boiler, ½, ⅝, 1 in. diameter by 2 to 5 in. sell as follows per 100 lb.:

New York...$6.00 Cleveland...$4.00 Chicago....$5.37 Pittsburgh...$4.72

Structural, same sizes:

New York...$6.10 Cleveland...$4.10 Chicago....$5.47 Pittsburgh....$4.82

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	32.00	34.00	35.00
Brass	30.50	34.00	34.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb. advance is 5c. over base (100-lb. lots); less than 50 lb., but not less than 25 lb. 10c. should be added to base price; quantities from 10-25 lb., extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet metal mouldings if ordered in above quantities. Above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ⅛-2 in. inclusive in rounds, and ⅛-1½ in., inclusive, in square and hexagon—all varying by thirty seconds up to 1 in. by sixteenths over 1 in. On shipments aggregating less than 100 lb., there is usually a boxing charge of $1.50.

LONG TERNE PLATE—In Chicago No. 28 primes from stock sell, nominally, for $8.50 per 100 lbs.

COTTON WASTE—The following prices are in cents per pound:

	— New York — Current	One Year Ago	Cleveland	Chicago
White	11.00@15.50	13.00	16.00	11.00 to 14.00
Colored mixed	7.00@10.50	9.00-12.00	12.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½x13½	13½x20½
Cleveland	55.00	65.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$2.25	$2.25	$1.75
Philadelphia	2.00	2.00	1.75
Cleveland	2.50	2.50	2.75
Chicago	2.25	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.40	$3.40	$3.65
Cleveland	4.25	4.25	3.62
Chicago	5.00	5.00	5.00

COKE—The following are prices per net ton at ovens, Connellsville:

	Apr. 22	Apr. 15	Apr. 8	Apr. 1
Prompt furnace	$11.00@$12.00	$11.00@$12.00	$11.00@$12.00	$6.00
Prompt foundry	12.00@ 13.00	12.00@ 13.00	12.00@ 13.00	7.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	Per Ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	— New York — Current	One Year Ago	Cleveland	— Chicago — Current	One Year Ago
Raw in barrels (5 bbl. lots)	$1.87	$1.61	$1.95	$2.05	$1.80
5-gal. cans (without cans)	1.87*	1.76	2.20	2.30	2.00

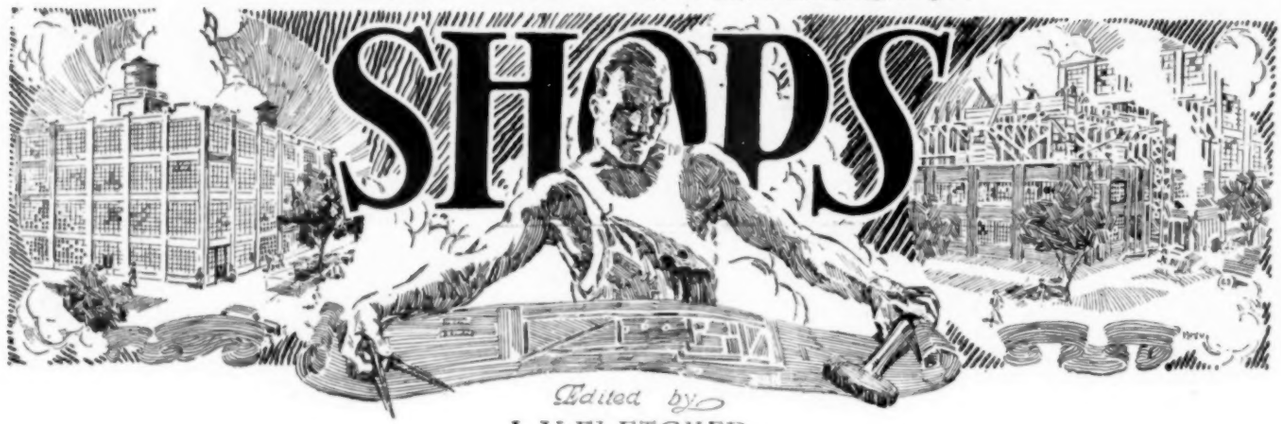
*To this *oil* price must be added the cost of the cans (returnable), which is $2.25 for a case of six.

WHITE AND RED LEAD—Base price per pound:

	— Red — Current Dry	Current In Oil	One Year Ago Dry	One Year Ago In Oil	— White — Current Dry and In Oil	One Year Ago Dry and In Oil
100 lb. keg	15.50	17.00	13.00	14.50	15.50	13.00
25 and 50-lb. kegs	15.75	17.25	13.25	14.75	15.75	13.25
12½-lb. keg	16.00	17.50	13.50	15.00	16.00	13.50
5-lb. cans	18.50	20.00	15.00	16.50	18.50	15.00
1-lb. cans	20.50	22.00	16.00	17.50	20.50	16.00

500 lb. lots less 10% discount. 2000 lb. lots less 10-2½% discount.

NEW and ENLARGED



Edited by
L-V-FLETCHER

Machine Tools

The following concerns are in the market for machine tools:

Conn., New Haven—J. V. Capuano, 65 Wallace St.—garage equipment.

Mass., Boston—The Boston Elevated Ry. Co., 101 Milk St., E. Mahler, Purch. Agt.—broaching cutter bars, 1⅝ in. wide, broaches 3¼ in. square, 56-in. stroke, similar to No. 3B manufactured by J. N. LaPointe, New London, Conn., and one 24- or 25-in. engine lathe, single friction, backgeared, 10-ft. bed with taper attachment, similar to the 25-in. heavy duty lathe of the LeBlond Machine Tool Co. Cincinnati.

Mass., East Boston—A. Pellucci, Chelsea St. —garage equipment.

Mass., Worcester—S. La Gasse, 6 Crown St. —garage equipment.

Md., Sparrows Point—The Bethlehem Steel Co.—motor-driven drill grinder suitable for 12-in. boring space.

N. J., Camden—The Camden Auto Radiator Repair Co., 507 Arch St.—crown and fender rolling machines, and beading machines.

N. J., Newark—The Van Sickelen Speedometer Co.—gear hobbers, shapers, millers, B. & S. automatics and high-speed drills.

N. J., Trenton—The United Globe Rubber Co. —jar ring lathe (used).

N. J., Verona—The Essex Co. Hospital—garage equipment.

N. Y., Alexandria Bay—Hutchinson Bros.—light machine tools for automobile and truck repair.

N. Y., Alexandria Bay—Thomson & Britton Co.—drill press and shaper.

N. Y., New York (Borough of Manhattan) —F. H. Niles & Co., Inc., Woolworth Bldg.—10 model "B", 2 or 2½ in. Cleveland automatic screw machines (used), and ten 10 x 36 in. Norton plain grinding machines (new).

N. Y., New York (Borough of Queens)—The Tock Screw Machine Products Corp., 203 8th St., Long Island City—5 No. 00, and 1 No. 1 B. & S. automatics.

N. Y., Redwood—The Kabel Bros.—arbor press and tool room lathe.

N. Y., Schenectady—The General Electric Co., River Rd., for Pittsfield, Mass., plant—one plain milling machine, equivalent to No. 3B Kearney & Trecker, motor driven.

N. Y., Watertown—F. F. O'Brien, State St.—power grinder.

Pa., Lester—**The Westinghouse Electric Co.** —motor-driven grinder, combination ring wheel and straight wheel.

Pa., Philadelphia—The Foster Mfg. and Supply Co., 20th and Venango Sts.—
One beading machine, hand or power.
One squaring shear, about 60-in. throat.
One power hack saw, about 12 in.
One sensitive bench drill, 0 to ¼ of 5/16 in., belt drive; (all new).

Pa., York—The York Screw Wks.—
One 16 in. x 6 ft. lathe.
One No. 3 grinder.
One 24-in. shaper.
One No. 3 milling machine.

N. C., High Point—The Harriss Covington Hosiery Mills—machine tools.

Va., Richmond—The Chesapeake and Ohio R.R. Co., 9th and Main Sts., B. T. Jelleson, Purch. Agt.—Amer. twist drill grinder, belt drive, style "C," capacity from ⅛ to 2½ in., and one wet drill grinder, style "W" or equivalent.

Va., Roanoke—The Norfolk and Western R.R.—
Double and single head bolt cutters, motor driven.
Jolt machine and core jolt machine, motor driven.
One 48-in. carwheel boring machine.
One 36-in. vertical turret lathe, double head.
One seat facing machine for slide valve.
One desk guard machine.
One 5-ft. sand-mixing machine.
One portable crank truing machine.
Two 48-in. car wheel lathes.
One 90-in. driving wheel lathe.
One piston rod grinding machine, 7-in. centers, gap to sling 40 in.
One No. 4 universal milling machine.
One No. 4 plane milling machine.
One 48-in. boring, milling and drilling machine.
One 750-ft. air compressor.
One forge blower, 3 fires.
One driving box boring machine.
One portable crank pin truing machine.
One hand bending roll.
One coil forming machine.
Two 500-ft. air compressors.
One 1,000-ft. steam-driven air compressor.

W. Va., Sisterville—The Sisterville Tank and Boiler Wks.—presses to flatten ends of 2-in. pipes, and to make clamps for erection of metal derricks.

Ill., Chicago—S. Elwell, 6200 Kenwood St. —one 13 or 14-in. screw-cutting lathe.

Ill., Chicago—The Lanski Co., 2331 Ogden Ave.—double spindle shaper and spindle carver.

Ind., Indianapolis—The Vonnegut Machinery Co., 43 South Meridan Ave.—1 Bickford thread milling machine (used).

Mich., Detroit—The Detroit Reliable Machine Co., 676 Grand Boulevard, W.—general machine shop equipment.

Mich., Detroit—The F-B Electric Mfg. Co., 29 East Atwater St.—small tool equipment.

Mich., Detroit—The Fitzgerald Wrench Co., Field and Jefferson Aves.—punch and emery grinder.

Mich., Detroit—The Grand Trunk Ry., Dinnan Bldg., 3rd St., A. N. Laird, Engr.—
One 5 ton high speed steam hammer for 100 lb. steam pressure.
One 16 in. gap lathe, motor driven.
One 36 in. gap lathe, motor driven.
One 24 in. back gear shaper, motor driven.
One single head Landis bolt threading machine, motor driven.
One 3 in. sliding head drill press, motor driven.
One No. 1 Ransom motor driven emery grinder, capacity two 12 x 2 in. emery wheels.
Air drill and small tools.
One combination cut off and rip saw, motor driven.
One double head wood boring machine.

Mich., Detroit—The Jefferson Forge Products Co., 2811 East Jefferson Ave.—power hammers and presses.

Mich., Detroit—The Keystone Tool Co., 25 East Fort St.—emery grinder and shaper.

Mich., Detroit—The Martin Tool Wks., 69 Holborne St.—die making machine.

Mich., Kalamazoo—The Shakespeare Co.—presses.

Mich., Pontiac—The Oakland Motor Car Co. —repair shop equipment.

O., Columbus—The Columbus Buick Co., 286 East Long St.—Service Dept., Purch. Agt.—1 grinder and other tools.

O., Columbus—The Columbus Cadillac Co., Sexton and Broad Sts., C. D. Beck, Purch. Agt. —1 36 in. lather (used).

O., Columbus—The Dobson Motor Co., 207 North Fourth St.—service station equipment, including presses, drills, lathes, etc.

O., Columbus—The Elgin Motor Sales Co., 162 North 4th St., O. O. Wilbert, Purch. Agt.—one 18 in. lathe and one small drill press.

O., Columbus—S. O. Holder, 142 South Burgess Ave.—one 20 in. x 10 ft. bed lathe with taper attachment, and one 30 or 36 in. band saw (used).

O., Columbus—The Ohio Auto Sales Co., 772 North High St., M. F. Milliken, Purch. Agt.—2 grinders.

O., Norwalk—W. M. Kuhlman, 70 West Main St.—one 20 in. drill press, one 18 in. lathe and one shaper.

Wis., Milwaukee—The Milwaukee Gas Specialty Co., 2017 Clybourn St.—forge automatic screw machines.

Minn., St. Paul—**The Knapp Sales Agency**, 339 Endicott Bldg.—1 straight-side, double geared power press, 10 in. stroke, 30 in. between uprights, 25 in. between bed and plungers, down stroke; (used).

Tex., Houston—The Mack Mfg. Co., Ltd., 821 Kress Bldg.—several heavy turret lathes, special machine shop equipment and a forging machine.

Ont., Toronto—The H. W. Petrie Co., Ltd., 131 Front St., W.—planers, shapers, boring mill and milling machine.

Machinery

The following concerns are in the market for machinery:

Md., Baltimore—The James Lumber Co., 98 Aliceanna St., equipment for planing mill, including band resaws, timber sizers, fast feed planers and matchers, gang ripsaws, etc.

N. J., Newark—The Amer. Brake Shoe Co., 30 Church St.—foundry equipment.

N. Y., Alexandria Bay—The Garlock Bros.—wood-working tools and machinery.

N. Y., Carthage—The St. Lawrence River Granite Co., Inc.—air compressors, pneumatic drilling, tools, saws and planers.

N. Y., New York (Borough of Manhattan) —The Begoon Trading Co., 23 Water St.—
One Clark band saw mill with 40 ft. carriage.
One vertical swing mill, to cut logs up to 90-95 cm. motor driven, 30 hp., 220 v.
One circular disk saw mill up to 36 ft., motor driven, 30 hp., 220 v.
One French saw mill.
One moulding machine.
One planer with moving table 10 m. long.
One universal woodworking machine, motor driven, 5 hp., 220 v.
Two automatic band saw sharpening machines.
One automatic saw sharpener.
One automatic planer blade sharpener.
Three woodworking lathes with plates.
One centrifugal blower, 25 hp., 220 v.

Pa., Dickson City—The Early Foundry Co. —foundry equipment.

Pa., Edwardsville—The Bernstein Silk Co.—50 silk throwing machines.

Pa., Edwardsville—The Wilbur Robson Silk Co.—75 silk throwing machines.

Ky., Louisville—The Bd. Educ.—
One vertical boring mill.
One bench planer, Wallace or equal, with flap and shutter safety guide.
One 14-in. bench band saw, Wallace or equal, with attached base and guard.
One universal saw, Wallace or equal.
One bench planer, 4-in. knife.
One band saw, 14-in. wheel.
One edging, rip and jointing saw.
One universal hook and eyelet machine.
One self-adjusting skiving machine, Progressive or equal.
One silent chain lathe, motor driven, and lathe tools.

Va., Danville—**The Westbrook Elevator Mfg. Co.**, 410 Spring St.—machinery and woodworking equipment, $30,000.

Va., Wheeling—The Atlas Glass Co.—automatic equipment for drawing zinc cups.

Mich., Charlotte—The Charlotte Chair Co.—woodworking equipment.

Mich., Detroit—The Food Products Co., 27 Bates St.—special machinery for making and handling food products.

Mich., Monroe—The Monroe Steel Castings Co.—General foundry equipment for making and finishing steel castings.

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave.—manual training equipment.

O., Columbus—The Immel Co., 31 East Livingstone Ave., A. F. King, Purch. Agt.—complete woodworking machinery and some metal working machinery.

O., Lakewood—The Bd. Educ.—manual training equipment.

Wis., Cudahy—The Federal Rubber Co—special rubber working machinery.

Wis., North Milwaukee—The Bernert Mfg. Co., 489 12th St., Milwaukee—sheet metal shears and roller.

Tex., Dallas—The Bd. Educ.—manual training equipment.

Metal Working

NEW ENGLAND STATES

Conn., Bridgeport—The Bryant Electric Co., 1421 State St., is preparing plans for the construction of a 4 story, 50 x 140 ft. addition to its factory, for the manufacture of electric specialties. Estimated cost, $125,000.

Conn., New Haven—J. V. Capuano, 65 Wallace St., has awarded the contract for the construction of a 1 story, 65 x 140 ft. garage on Chapel St. Estimated cost, $30,000. Noted Mar. 4.

Me., Portland—The Henley & Kimball Co., 380 Forest Ave., is having plans prepared by R. A. Rumery & Co., Archts., 21 Portland St., for the construction of a 4 story, 100 x 100 ft. factory on Forest Ave., for the manufacture of automobiles. Estimated cost, $105,000.

Mass., Athol—The Union Twist Drill Co. has awarded the contract for the construction of a 4 story 60 x 200 ft. addition to its plant, for the manufacture of tools. Estimated cost, $150,000. Noted Apr. 8.

Mass., Boston—The W. B. Rice Estate, c/o L. C. Greenleaf, Archt., 101 Tremont St., has awarded the contract for the construction of a 1 story, 197 x 295 ft. garage and machine shop. Estimated cost, $150,000. Noted Mar. 4.

Mass., Worcester—S. La Gasse, 6 Crown St., will soon award the contract for the construction of a 1 story, 67 x 120 ft. garage, on Pleasant and Merrick Sts. Estimated cost, $30,000.

R. I., East Providence—The Abrasive Machine Tool Co., Dexter Rd., has awarded the contract for the construction of a 1 story, 50 x 110 ft. factory. Estimated cost, $30,000.

R. I., East Providence (Providence P. O.)—J. Avilla, 404 Wickendon St., will soon award the contract for the construction of a 1 and 2 story, 50 x 100 ft. garage. Estimated cost, $30,000. Marshak & Hickey, 310 Stranx Bldg., Archts.

R. I., Pawtucket—The Fales & Jenks Machine Co., 320 Dexter St., has awarded the contract for the construction of a 3 story, 45 x 80 ft. factory on Pine St., for the manufacture of textile machinery. Estimated cost, $50,000.

R. I., Pawtucket—The Phillips Insulated Wire Co., Freeman St., has awarded the contract for the construction of a 1 story, 45 x 85 ft. factory on Winthrop Ave. Estimated cost, $15,000.

R. I., Providence—L. E. Danforth, 76 Dorrance St., will build a 1 story, 100 x 200 ft. garage and service station on Broad St. Estimated cost, $85,000. Noted Apr. 8.

R. I., Providence—The Diamond Co., 325 Fountain St., will soon award the contract for the construction of a 1 story, 50 x 140 ft. garage on Battery St. Estimated cost, $35,000. Noted Apr. 8.

R. I., Providence—C. A. Potter, Crary St., will soon award the contract for the construction of a 1 story, 40 x 135 ft. garage on Bridgeman and Cranston Sts. Estimated cost, $30,000. Noted Apr. 8.

R., I., Providence—W. L. Wilcox, 322 Bway., has awarded the contract for the construction of a 1 story, 60 x 165 ft. garage and service station on Elmwood and Lenox Aves. Estimated cost, $40,000. Noted Mar. 4.

Vt., Derby Line—Butterfield & Co. has awarded the contract for the construction of a 3 story, 65 x 200 ft. addition to its plant, for the manufacture of taps and dies. Estimated cost, $100,000. Noted Apr. 1.

MIDDLE ATLANTIC STATES

Md., Baltimore—The General Electric Co., River Rd., Schenectady, N. Y., has purchased the plant of the Bartlett Hayward Co., on Columbia Ave. near the Baltimore and Ohio R.R., here, and will install equipment for the manufacture of slates, switchboards and other small apparatus.

N. J., Verona—The Essex Co. Hospital will soon award the contract for the construction of a garage, laundry, storehouse, etc. Estimated cost, to exceed $500,000.

N. Y., Buffalo—The Amer. Brass Co., Grand and Meadow Sts., Waterbury, Conn., will build a 165 x 650 ft. rolling mill at 446 Military Rd. Estimated cost, $600,000.

N. Y., Buffalo—The Kam Kaderback Co., 967 Main St., has awarded the contract for the construction of a 2 story, 60 x 120 ft. garage and service station at 1120 Main St. Estimated cost, $150,000.

N. Y., Jamaica—J. Hessler & Son, 18 Cedar St., New York City, will soon award the contract for the construction of a 3 story factory for the manufacture of bookbinding devices. Estimated cost, $50,000. Noted Apr. 22.

N. Y., Jamaica—P. Trainer & Co., 110 Green St., Brooklyn, will soon award the contract for the construction of a 5 story factory on Hill and Gale Sts., for the manufacture of motor cars.

N. Y., Jamestown—The Forge Tool Products Corp., recently incorporated with $500,000 capital stock plans to build a large plant for the manufacture of forged steel wrenches and other forged products. W. H. Hjorth, Pres.

N. Y., New York (Borough of Brooklyn)—S. Ageloff, c/o T. Goldstone, 50 Graham Ave., will build a 1 story, 100 x 100 ft. garage on Humboldt St. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—The Amer. Safety Razor Co., 303 Jay St., has awarded the contract for the construction of a 5 story, 75 x 140 ft. and a 1 story, 25 x 125 ft. factory, a 2 story 45 x 50 ft. garage, and a 1 story, 25 x 50 ft. boiler house, on Lawrence, Johnson and Jay Sts. Noted Jan. 29.

N. Y., New York (Borough of Brooklyn)—E. F. Corll, c/o I. Canton, Archt. and Engr., 373 Fulton St., will build a 1 story, 100 x 100 ft. garage on Pitkin Ave. Estimated cost, $55,000.

N. Y., New York (Borough of Brooklyn)—G. Doscher, c/o P. Steigman, Archt., 690 Bway., will build a 2 story, 100 x 100 ft. garage, on Bedford Ave. Estimated cost, $60,000.

N. Y., New York (Borough of Brooklyn)—The Factory Constr. Co., 44 Court St., will build a 1 story, 100 x 130 ft. garage on Crescent Ave. and 13th St. Estimated cost, $40,000.

N. Y., New York (Borough of Brooklyn)—The P. T. and J. L. Improvement Co., 1715 Sterling Pl., will build a 1 story, 100 x 100 ft. garage on Fulton St. and Waverly Pl. Estimated cost, $35,000.

N. Y., New York (Borough of Brooklyn)—S. Norris, 1158 President St., will build a 1 story, 100 x 100 ft. garage on Cypress Ave and Hancock St. Estimated cost, $25,000.

N. Y., New York (Borough of Manhattan)—G. H. Budke, 561 West 175th St., is having plans prepared by S. J. Kessler, Engr., 529 Cortlandt St., for the construction of a 2 story, 100 x 124 ft. garage at 315 West 69th St. Estimated cost, $100,000.

N. Y., New York (Borough of Manhattan)—L. Gold, 44 Court St., Brooklyn, will build a 5 story, 100 x 110 ft. garage at 239 West 64th St., here. Estimated cost, $200,000.

N. Y., New York (Borough of Manhattan)—Marcus & Goldstein, Inc., 175 East 96th St., will build a 2 story, 98 x 100 ft. garage at 330 West 41st St. Estimated cost, $50,000.

N. Y., New York (Borough of Manhattan)—J. Massininni, c/o E. Wilbur, Archt., 507 5th Ave., will build a 1 story, 50 x 50 ft. garage on 162nd St. Estimated cost, $35,000.

N. Y., New York (Borough of Manhattan)—M. Rothbart, 1411 Grand Concourse, will build a 1 story, 75 x 131 ft. garage on 3rd Ave. and 140th St. Estimated cost, $85,000.

N. Y., Syracuse—The M. L. Oberdorfer Brass Co., 804 East Water St., is building a brass foundry on Messina Springs Rd. Estimated cost, $500,000.

Pa., Dickson City—The Early Founry Co. plans to build a 90 x 200 ft. foundry on Main Rd. to be 38 ft. high. Estimated cost, $200,000.

Pa., Johnstown—The Cambria Steel Co., Widener Bldg., Philadelphia, will soon award the contract for the construction of a 60 x 140 ft. electrical repair shop at its plant, here.

SOUTHERN STATES

Ala., Birmingham—The Dixie Brass and Foundry Co., 6the Ave., N., plans to build an addition to its plant. Estimated cost, $50,000.

Ky., Louisville—J. D. Rommel, 966 South 3rd St., will build a garage. Estimated cost, $40,000.

La., New Orleans—The H. Van Horn Co., 518 Camp St., is having plans prepared by J. Fromherz, Engr., Title Guarantee Bldg., for the construction of a 3 story factory on Lafayette Sq., for the manufacture of machinery and machine tools. Estimated cost, $100,000.

Va., Danville—The Westbrook Elevator Mfg. Co., 410 Spring St., has awarded the contract for the construction of a 2 story, 60 x 180 ft. factory. Estimated cost, $50,000.

MIDDLE WEST

Ill., Chicago—The Casey Hudson Co., 361 East Ohio St., is having plans prepared by E. A. Mayo, Archt., 53 West Jackson Bldg., for the construction of a 1 and 2 story, 300 x 300 ft. factory on North Central and Grand Aves., for the manufacture of screw machine products. Estimated cost, $300,000.

Ill., Chicago—The Home Stove Wks., 2606 West 18th St., will soon award the contract for the construction of a foundry on 18th Place and Washtenaw Ave.

Ill., Chicago—The McDonald Machine Co., 3203 Shields Ave., has awarded the contract for the construction of a 1 story, 150 x 400 ft. machine shop at 7600 South Racine Ave. Estimated cost, $250,000.

Ind., Fort Wayne—J. H. and W. C. Ely, Firemans' Trust Bldg., Newark, N. J., will soon award the contract for the construction of a 2 story bulb factory here, for the General Electric Co.

Mich., Bay City—The Garber Buick Co., 1109 Washington Ave., is having plans prepared by R. E. Bickel, Archt., Bay City, for the construction of a 1 story, 100 x 100 ft. garage and sales building. Estimated cost, $35,000.

Mich., Detroit—The Clayton Lambert Co., 1380 Beaubien St., has awarded the contract for the construction of a 1 story, 210 x 300 ft. factory on Knodell Ave., along the tracks of the Detroit Terminal Ry., for the manufacture of pressed metal products. Noted Jan. 8.

Mich., Detroit—A. J. Detlaff, East Lafayette St., will soon award the contract for the construction of a 1 story, 51 x 88 ft. foundry on Lafayette and Hastings Sts. Estimated cost, $10,000.

Mich., Detroit—Dodge Bros., Joseph Campeau Ave., have awarded the contract for the construction of an 8 story, 77 x 266 ft. auto body press shop on Conant Ave.

Mich., Detroit—J. Harley, Cass Ave., is having plans prepared by Williams Bros. and H. W. Dorst, 1111 Kresge Bldg., for the construction of a 2 story, 45 x 120 ft. garage on Cass and Selden Aves. Estimated cost, $30,000.

O., Cleveland—The Jordan Motor Co., 1070 East 152nd St., has awarded the contract for the construction of a 1 story, 70 x 620 ft. factory, and a 3 story, 34 x 48 ft. power house on East 152nd St., near St. Clair Ave. Estimated cost, $300,000. Paul Zens, Secy.

O., Cleveland—The Laundryette Mfg. Co., 1190 East 152nd St., has awarded the contract for the construction of a 3 story, 200 x 200 ft. factory. Estimated cost, $200,000.

O., Cleveland—The Loew Mfg. Co., West 90th St. and Madison Ave., plans to build an addition to their factory for the manufacture of pumps. Estimated cost, $200,000.

O., Cleveland—The Natl. Acme Co., East 131st St. and Coit Rd. manufacturer of machinery, has awarded the contract for the construction of a 1 story addition to its factory. Estimated cost, $250,000. Noted Apr. 22.

O., Cleveland—The Superior Fdry. Co., East 71st St. near the Lake Erie R.R., has awarded the contract for the construction of a 2 story, 60 x 200 ft. foundry. Estimated cost, $100,000.

O., Cleveland—The Superior Tractor Co., Hickox Bldg., is having plans prepared by G. S. Rider & Co., Archts. and Engrs., Century Bldg., for the construction of a 1 story, 100 x 300 ft. factory on St. Clair Ave. and East 200th St. Estimated cost, $150,000.

O., Cleveland—D. D. Wessels, 1386 East 17th St., manufacturer of plumbing supplies, has purchased a site on East 21st St. and Oregon Ave., and plans to build a 2 story, 32 x 130 ft. and a 100 x 116 ft. factory. Estimated cost, $125,000.

Wis., Burlington—The Burlington Brass Wks. will build a 1 story, 100 x 140 ft. foundry. Noted Apr. 1.

Wis., Menasha—The W. Wentink Co., has had plans prepared for the construction of a factory at the western end of 3rd St., for the manufacture of filter mass, car movers and many small patented appliances. Estimated cost, $100,000.

Wis., Milwaukee—Lindemann & Hoverson Co., 1st and Cleveland Aves., is having plans prepared by Klug & Smith, Archts., Mack Bldg., for the construction of a 1 story, 60 x 80 ft. annealing plant on 1st Ave. Estimated cost, $25,000.

Wis., Milwaukee—The Milwaukee Reliance Boiler Wks., 1102 32nd St., has awarded the contract for the construction of a 1 story, 60 x 300 ft. boiler shop. Estimated cost, $60,000.

Wis., Milwaukee—The Natl. Brake and Electric Co., Belleview Place, is having plans prepared by H. J. Esser, Archt., Camp Bldg., for the construction of a 1 story, 160 x 180 ft. addition to its foundry. Estimated cost, $150,000.

Wis., Sheboygan—Helming Bros. Co. will soon award the contract for the construction of a 3 story, 60 x 150 ft. garage on Erie Ave. Estimated cost, $100,000.

Wis., South Milwaukee—The Lawson Airplane Co., 425 East Water St., Milwaukee, is preparing plans for the construction of a 1 story, 70 x 160 ft. assembling plant, here.

WEST OF THE MISSISSIPPI

Ia., Davenport—The White Lily Mfg. Co. has awarded the contract for the construction of a 1 story, 210 x 285 ft. plant, at 1535 Rockingham Rd., to include a garage, show room, power and printing plant and office building. Estimated cost, $200,000.

Ia., Waterloo—The Waterloo Gas Engine Co. has awarded the contract for the construction of a 3 story, 100 x 120 ft. factory. Estimated cost, $500,000.

Minn., Minneapolis—The Lincoln Motor Sales Co., 219 Metropolitan Bank Bldg., is having plans prepared by Long, Lamoreaux & Thorsov, Archts., Andrus Bldg., for the construction of a 2 story, 66 x 145 ft. factory, on 12th St. and Harmon Place. Estimated cost, $125,000.

Mo., St. Louis—R. H. Brock, 4386 Olive St., has awarded the contract for the construction of a 1 story, 100 x 155 ft. garage and machine shop, at 4416-20 Olive St. Estimated cost, $24,800.

Mo., St. Louis—The Eureka Brass Co., 615-19 Red Bud St., has awarded the contract for the construction of a 1 story, 50 x 148 ft. foundry addition.

Mo., St. Louis—The Lewis Felling Machine Co., 3763 Forest Park Blvd., has awarded the contract for the construction of a 1 story, 65 x 119 ft. addition to its machine shop. Estimated cost, $11,000.

Mo., St. Louis—The Natl. Enameling and Stamping Co., 2d and Destrahan Sts., has awarded the contract for the construction of a 1 story, 60 x 120 ft. shop, at 3406-8 North 2nd St. Estimated cost, $8,500.

CANADA

Ont., Essex—The Essex Tractor Co. plans to build a 1 and 2 story addition to its plant for the manufacture of traction engines. Estimated cost, $50,000.

Ont., Guelph—The Commerce Motor Trucks Co., Ltd., is having plans prepared by the E. A. James Co., Ltd., Engrs. and Archts., 36 Toronto St., for the construction of a 1 story, 90 x 300 ft. factory on York Rd. Estimated cost, $100,000. Noted Apr. 15.

Ont., Toronto—The Canadian Tygard Engine Co., Kingston Rd., has awarded the contract for the construction of a 2 story, 50 x 160 ft. factory for the manufacture of carbureters and engines. Estimated cost, $40,000.

Ont., Waterloo—The International Eng. Corp. plans to build three 1 story, 50 x 100 ft. buildings for the manufacture of gas engines. Estimated cost, $100,000.

General Manufacturing

NEW ENGLAND STATES

Conn., Danielson—The Goodyear Tire and Rubber Co., East Market St., Akron, O., has awarded the contract for the construction of a 1, 2 and 4 story plant, here. Estimated cost, $3,500,000.

Conn., Middletown—The Goodyear Rubber Co., 114 Church St., has awarded the contract for the construction of a 3 story, 50 x 220 ft. and a 30 x 50 ft. factory for the manufacture of boots and shoes. Estimated cost, $100,000. Noted Apr. 8.

Conn., Middletown—W. S. Miller, 37 Washington St., has awarded the contract for the construction of a 1 story, 40 x 70 ft. addition to his factory, for the manufacture of paper boxes. Estimated cost, $18,000.

Mass., Dover—The T. G. Plant Co., Jamaica Plain, Mass., is preparing plans for the construction of a 4 story, 50 x 200 ft. addition to its plant here, for the manufacture of shoes. Estimated cost, $100,000.

Mass., Holyoke—The Hampden Glazed Paper and Card Co., Riverside, has awarded the contract for the construction of a 2 story addition to its plant. Estimated cost, $125,000.

Mass., Mittenengue—The Strathmore Paper Co. has awarded the contract for the construction of a 5 story, 32 x 50 ft. addition to its plant. Estimated cost, $30,000.

Mass., Pittsfield—The General Electric Co., Columbus Ave., is preparing plans for the construction of a 1 story, 100 x 400 ft. factory on Moringside St., for the manufacture of insulation porcelain. Estimated cost, $250,000.

Mass., Woolaston (Boston P. O.)—The Howard Chemical Co., c/o E. R. Simpson, Engr., 176 Federal St., Boston, will soon award the contract for the construction of a 3 story, 55 x 120 ft. factory on Old Colony Ave. Estimated cost, $50,000.

Mass., Worcester—The Worcester Tire Fabric Co., 98 Union St., has awarded the contract for the construction of a 4 story, 75 x 145 ft. factory on Union and Market Sts. Estimated cost, $150,000.

Mass., Wrentham—The Commonwealth of Massachusetts, c/o Kendall Taylor Co., Archts., 93 Federal St., Boston, is having plans prepared for the construction of a 1 story, 50 x 70 ft. cold storage plant and a 1 story, 40 x 90 ft. industrial building. Estimated cost, $88,000.

MIDDLE ATLANTIC STATES

Md., Baltimore—The James Lumber Co., 921 Aliceanna St., is building a large planing mill on Aliceanna and President Sts.

Md., Baltimore—The Locke Insulator Co., Victor, N. Y., has awarded the contract for the construction of two 1 and 2 story factories and 24 brick kilns on Light St. and Ferry Bar, here, for the manufacture of porcelain insulators. Estimated cost, $1,000,000. Noted Jan. 29.

Md., Baltimore—The Natl. Enameling and Stamping Co., Race and Ostend Sts., will soon award the contract for the construction of a 3 story, 61 x 76 ft. addition to its plant. Estimated cost, $100,000.

Md., Curtis Bay (Baltimore, P. O.)—The Union Acid Wks. has awarded the contract for the construction of a 2 story, 200 x 500 ft. acid plant, on Aspin St. and Railroad Ave. Estimated cost, $200,000.

N. J., Newark—G. H. Fritz & Sons, 70-72 J St., have awarded the contract for the construction of a 1 story, 60 x 100 ft. factory for the manufacture of candy, and a 20 x 28 ft. storehouse. Noted Apr. 22.

N. J., Newark—J. E. Ortner, 481 Washington St., has awarded the contract for the construction of a 1 story, 40 x 90 ft. factory on 20th and Beverly Sts., for the manufacture of novelties. Estimated cost, $15,000.

N. Y., Gates (Lincoln Park P. O.)—The Yawman & Erbe Co., 424 Saint Paul St., Rochester, manufacturer of filing devices and office supplies, has increased its capital stock from $1,500,000 to $3,000,000, and plans to build a new plant here. Estimated cost, $400,000.

N. Y., Glenfield—The Dexter Sulphite Pulp and Paper Co., Dexter, plans to build a large sawmill, here. Cost between $75,000 and $100,000.

N. Y., Jamaica—The A. L. Read Co., Jamaica Ave. and 121st St., Richmond Hill, has awarded the contract for the construction of a 2 story, 70 x 125 ft. factory, for the manufacture of leather good. Estimated cost, $75,000.

N. Y. Lockport—The Dairymens League of Niagara County plans to build a plant for milk condensing and manufacture of ice cream. Estimated cost, $250,000. E. N. Olds, Pres.

N. Y., Mt. Vernon—Armour & Co., 208 South LaSalle St., Chicago, is having plans prepared by R. C. Clark, Engr. and Archt., Union Stock Yards, Chicago, for the construction of a 5 story packing plant, here.

N. Y., New York (Borough of Brooklyn)—J. Kroder and H. Reubel, 108 Meeker Ave., are having plans prepared by R. Berger, Archt. and Engr., 309 Bway., New York City, for the construction of a 129 x 150 ft. factory on North Henry St., for the manufacture of draperies and carpets. Estimated cost, $150,000.

N. Y., New York (Borough of Manhattan)—The Majestic Mills Paper Co., 464 Broome St., will build a 6 story factory. Estimated cost, $25,000.

N. Y., New York (Borough of Queens)—E. Ronzoni, manufacturer of macaroni, has awarded the contract for the construction of a 5 story addition to his factory on Jackson Ave., Long Island City. Estimated cost, $50,000.

N. Y., New York (Borough of Queens)—The P. Van Iderstine Corp., Greenpoint Ave., Long Island City, will soon award the contract for the construction of a factory here, for the manufacture of oil products.

N. Y., Utica—The K. F. Textile Mills Co. has awarded the contract for the construction of a 2 story, 54 x 72 ft. factory at 614 Broad St. Estimated cost, $25,000.

Pa., Jeannette—The Amer. Window Glass Co., Farm Bank Bldg., Pittsburgh, plans to build a 1 story, 42 x 180 ft. cutting room, here.

Pa., Lock Haven—The New York and Pennsylvania Co., 200 5th Ave., New York City, manufacturer of pulp and paper, has awarded the contract for the construction of a 2 story, 425 x 515 ft. mill, and a 1 story, 60 x 150 ft. garage. Estimated cost, $1,500,000.

Pa., Wilkes-Barre—The Sheldon & Leach Silk Co. has awarded the contract for the construction of a 1 story, 100 x 100 ft. silk mill on Gilligan St. Estimated cost, $150,000.

Pa., Wilkes Barre—The Woodlawn Dairy Corp. plans to build a 2 story, 50 x 125 ft. dairy on North Washington St. Estimated cost, $100,000.

SOUTHERN STATES

Ky., Louisville—The Stoll Oil Refining Co., 733 River Rd., is building a 1 story, 44 x 60 ft. filter house.

N. C., High Point—The Harriss Covington Hosiery Mills have awarded the contract for the construction of a 2 story, 50 x 100 ft. and 40 x 60 ft. hosiery mill, on Cox St. Estimated cost, $35,000.

MIDDLE WEST

Mich., Battle Creek—The Clean Sweep Co., 18 Fountain St., W., is having plans prepared by A. B. Chanel, Archt., Battle Creek, for the construction of a 1 story, 139 x 183 ft. factory for the manufacture of sweeping compounds. Estimated cost, $30,000.

Mich., Bay City—The Amer. Worsted Yarn Co., c/o D. L. Galbraith, Archt., is preparing plans for the construction of a 4 story, 120 x 400 ft. factory on Water St. Estimated cost, $300,000.

Mich., Detroit—H. S. Barber, 181 Beaufait Ave., is preparing plans for the construction of a 1 and 2 story, 96 x 120 ft. warehouse and factory for the manufacture of stained shingles. Estimated cost, $25,000.

Mich., Port Huron—The Aksala Chemical Co., 7430 South Chicago Ave., Chicago, is preparing plans for the construction of a 2 story factory on Water St. here, for the manufacture of automobile accessories, including lubricators and non freezing compound. Estimated cost, $50,000.

O., Cleveland—The Bd. Educ., East 6th St. and Rockwell Ave., plans to build a 1 story, 20 room addition to the High School on West 93rd St. and Williard Ave., to include a manual training department, etc. Estimated cost, $350,000.

O., East Liverpool—The Davidson Porcelain Co. has awarded the contract for the construction of a factory to cover 40,000 sq.ft. of floor space. Estimated cost, $40,000.

O., Elyria—The Lakeshore Rubber Co., 734 Natl. City Bldg., Cleveland, is having plans prepared by the Akron Eng. Co., Akron, for the construction of a 3 story, 80 x 240 ft. factory, along the tracks of the New York Central R.R. Estimated cost, $125,000.

O., Youngstown—C. L. Cliff, R. F. D. 3, clk., Liberty Twp. School Bd., will soon award the contract for the construction of a school on Churchill St., to include a manual training department.

Wis., Sheboygan—The Rexine Co., South River St., plans to build a 4 story, 60 x 200 ft. factory for the manufacture of soap and oils. Cost between $45,000 and $50,000.

WEST OF THE MISSISSIPPI

Minn., Hancock—The Bd. Educ. will soon award the contract for the construction of a 60 x 110 ft. school, to include a manual training department. Noted Mar. 11.

Mo., Kansas City—The Lysle Milling Co., 512 Choctaw St., Leavenworth, plans to build a flour mill, here. Estimated cost, $500,000.

N. D., Grand Forks—The State Industrial Comm., Bismarck, has awarded the contract for the construction of an 8 story, 40 x 160 ft. mill and a 60 x 120 x 140 ft. elevator, near the Fairgrounds, here. Estimated cost, $1,500,000. Noted Mar. 11.

Tex., Corsicana—The Corsicana Cotton Mills are having plans prepared for the construction of a 2 story factory, to have several thousand spindles and nearly 100 looms. Estimated cost, $95,000.

Tex., Whitesboro—The Whitesboro Oil and Refining Co. has awarded the contract for the construction of an oil refinery, to have a daily capacity of 2,000 bbl. Estimated cost, $150,000.

CANADA

N. B., Clair—The Norte Dame Lumber Co. will soon award the contract for the construction of a lumber mill on Kennedy Island, near here.

N. B., Springfield—S. Scott plans to develop power from the St. John River, and build a sawmill near here.

Ont., Beamsville—The Premier Tire and Rubber Co. plans to build a plant. Estimated cost, $250,000.

Ont., Toronto—The Cutter & Foster Co., L'd., 302 Church St., plans to build a 6 or 7 story factory for the manufacture of auto tops. Estimated cost, $150,000.

Ont., Toronto—The University of Toronto plans to build a new press building. Estimated cost, $70,000.

Que., Oscalana—The St. Regis Paper Co., 337 Franklin St., Watertown, N. Y., plans to build a cutting-up plant and sawmill, here. Estimated cost, $50,000. C. C. Burns, Mgr.

Sask., Saskatoon—The North Star Oil Refining Co. will soon award the contract for the construction of a refinery.

See Pages 401 to 438

"OPPORTUNITY" ADVERTISING
SEARCHLIGHT SECTION

See Pages 401 to 438